The Health Consequences of Negative Wealth Shock During Late Middle Age

by

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List of Acronyms

ACA Affordable Care Act

ADL Activities of daily living

BMI Body mass index

CD Certificate of deposit

CES-D Center for Epidemiologic Studies Depression scale

CI Confidence interval

CODA Children of the Depression

CRN Cost-related medication non-adherence

C-stat Concordance statistic

EBB Early Baby Boomers

GEE Generalized estimating equations

HPA Hypothalamic–pituitary–adrenal

HRS Health and Retirement Study

IPW Inverse probability weight

IRA Individual retirement account

MBB Mid Baby Boomers

MSM Marginal structural model

NDI National Death Index

OR Odds ratio

SD Standard deviation

SE Standard error

SES Socioeconomic status

SSDI Social Security Death Index

TICS Telephone interview for cognitive status

WB War Babies

Abstract

There is robust empirical evidence for a link between lower economic status and adverse health outcomes, but little is known about whether a sudden, unplanned loss of assets – a negative wealth shock – has long-term health consequences. Previous research has shown associations between negative wealth shocks and short-term health declines, primarily from losses of housing and investment wealth, with macroeconomic recession presumed to have triggered these shocks. Even during better economic times, however, negative wealth shocks arise frequently from more individualized circumstances, such as high medical expenses, but causal mechanisms linking subsequent health outcomes to these endogenous shocks can be difficult to establish due to the potential for reverse causality and residual confounding.

Using data from the Health and Retirement Study, a nationally representative study of US adults aged 50 and older, this dissertation examined markers of short-term changes in stress and health care consumption after negative wealth shock in late middle age, a time of particular vulnerability. Then, differences by whether an individual experienced negative wealth shock in late middle age were assessed for three long-term aging-related trajectories – cognitive decline, physical function limitation accumulation, and all-cause mortality. Design and analytic methods addressed bidirectional and time-dependent causation in the relationship between negative wealth shock and health outcomes.

Over 15% of late middle-aged adults with existing assets experienced negative wealth shock. The main findings indicated that experiencing a negative wealth shock during late middle

age was associated with a higher risk of elevated depressive symptoms, a marker of increased stress, as well as long-term risk of mortality and cognitive decline. However, there was no significant association between negative wealth shock and risk of cost-related medication non-adherence – a marker of reduced health-related consumption, nor accelerated physical function limitation accumulation.

With a substantial proportion of the late middle-aged population experiencing negative wealth shock, targeted interventions to prevent of the occurrence of these shocks and the health consequences thereafter may have a large impact on the health of older Americans.

Chapter 1

Introduction

1.1 Overview

Differences in health outcomes by economic status are among the most widely documented health disparities,[1-8] with better health outcomes linearly corresponding to higher economic status in what is termed the social gradient in health.[9,10] These disparities exist for a wide variety of diseases and conditions across the life course, from adverse birth outcomes and infant mortality to life expectancy at age 65 and incidence of Alzheimer's disease.[11-14] Multiple measures of economic status – including income and wealth – have been documented as influential, as have multiple levels of exposure – such as neighborhood poverty or household income.[15,16] This gradient even persists in conjunction with other social determinants of health; for example, health is associated with economic status within racial, ethnic, and educational attainment categories.[17-18]

The pathway from economic resources to health is hypothesized to operate primarily through consumption, by which income and assets are converted to expenditures on health-enhancing environments and behaviors.[19] As outlined in the theory of fundamental causes, economic resources can also confer an elevated position in the social hierarchy, where factors like prestige, power, and social participation lead to health advantage.[20] If economic status offers increased access to health-enhancing goods and services as well as an elevated social position, it is conceivable a sudden loss of economic resources – a negative shock – will diminish those benefits. Furthermore, the strain of losing those benefits might activate a stress response.[21]

The objective of this dissertation is to examine the health consequences of a specific type of economic resource loss: negative wealth shock. We hypothesize that a negative wealth shock in the years preceding retirement will be a highly stressful life event that has long-lasting effects on health through changes in health-related consumption and lower relative social position. To test this hypothesis, we examine short-term changes in markers of stress and health care consumption after negative wealth shock, and then assess three long-term aging-related trajectories – cognitive decline, physical function limitation accumulation, and mortality – for differences by whether an individual experienced negative wealth shock in late middle age.

1.2 Previous Research on Negative Shocks to Economic Resources

The Great Recession of 2007-2009 involved a large-scale increase in negative shocks to economic status, including dramatic stock market losses, high rates of home foreclosures, and increases in long-term unemployment.[22] In the years following the Recession, there has been increased research interest in the potentially deleterious health effects of these negative shocks. Because the Recession occurred only recently, the majority of the literature covers short-term health changes, though several studies have included retrospective exposure to periods of macroeconomic downturns from earlier in the life course.

Ecologic studies that examine population-level economic and health indicators as well as studies that ascribe area-level economic indicators to individual-level health data have been mixed in the findings of associations with economic downturn and health. While suicide mortality is consistently found to increase during economic downturn, overall population-level mortality appears to decline during recessionary periods.[23-27] Higher state-level foreclosure rates are associated with increases in state-level suicide rates, as are higher state-level unemployment rates.[28,29] The Great Recession time period, as compared to the time periods prior to the Recession, saw an increase in the population prevalence of major depression,[30] and a decrease in fruit and vegetable consumption.[31-32] Residing in areas with higher levels of home foreclosures is associated declines in mental health,[33-34] increases in systolic blood pressure,[35] and elevated body mass index,[36] but increases in local-area unemployment rates are not associated with changes in body mass index or other health behaviors.[37]

The mixed findings may in part be due to ecologic fallacy; the population-level experience may not accurately describe individual-level experiences.[38] Some research has disentangled personal shocks from macroeconomic shocks, finding that experiencing unemployment during economic downturn is associated with increased risk of cardiovascular disease and all-cause mortality, while not experiencing unemployment during economic downturn is associated with decreased risk of these outcomes.[39-41] The duality of those results may be the reason for the inconsistent associations of health outcomes and macroeconomic shocks.

Individual-level research that examines negative shocks to personal economic resources has consistently demonstrated short-term health changes. Declines in housing wealth and home foreclosure, declines in the value of investment holdings due to stock market volatility, bankruptcy, and catastrophic financial loss due to fraud are associated with increased risk of mental health conditions, including major depressive disorder and suicide.[42-52] Home foreclosures have also been associated with increased substance use and foregoing needed medical care.[53,54] Furthermore, financial strain has been shown to mediate the association between involuntary job loss and depression.[55,56]

Specific emotional states and non-stable personality traits have been associated with loss of economic resources, and may mediate the association between negative shocks to personal economic resources and health outcomes. Negative shocks to income and wealth levels during late middle age are associated with a reduced sense of control,[57] and home foreclosures are associated with increased stigma and loss of status.[58]

The extant research has added much understanding to the health risks of economic loss and mechanisms for these risks. Nevertheless, several gaps emerge from a review of the literature. First, the majority of previous studies tend to look at loss of a single asset, such as experiencing foreclosure or stock market loss, which limits inference to those who own the particular assets. Economic research has shown differences in the assets that comprise total household wealth by race and ethnicity. Blacks and Hispanics have lower levels of home and stock ownership than non-Hispanic Whites, even when controlling for income and educational attainment.[59] Second, previous research tends to focus on recession-based shocks, and it is presumed these shocks are attributable to exogenous macroeconomic effects. Exogenous shocks have the advantage of more straightforward causal interpretation, as there is little potential for reverse causality and fewer potentially confounding variables. Negative shocks to economic resources can also arise from personal circumstances, such as major illness onset and the resultant medical bills, which is the leading cause of personal bankruptcy filings.[60] Little is known about the health effects of negative shocks spurred by both exogenous and endogenous circumstances. Lastly, because most of the previous work has focused on the Great Recession of the late 2000s, health outcomes of interest have tended toward short-term changes in mortality, mental health, and health behaviors, partially due to limited follow-up time since the Recession. As such. the long-term health consequences of individual-level negative shocks have not been examined. This dissertation aims to add evidence that will help to fill these gaps.

1.3 Theoretical Foundations of Wealth and Aging

Though "wealth" and "income" are sometimes used interchangeably, "wealth" refers to an individual's or household's sum of possessions, properties, and savings – assets – that have value in the market economy and have been accumulated throughout the life course, while "income" generally refers to a cross-sectional measure of financial resources that are incoming within a given year. Net worth further refines the value of accumulated assets by subtracting unpaid debts from the sum total of one's assets, and is perhaps a more nuanced term for total wealth.[17] In late-middle and older ages, the differences in total wealth between those with the highest amount of resources and lowest amount of resources are wider than at earlier ages in the life course, while differences in income tend to flatten in later life due to retirement. For aging populations, wealth/net worth thus can be a more valid predictor of health than current income.[61]

Economic Theories of Wealth and Consumption

There are two interrelated economic theories that underpin the increased salience of wealth as a predictor of health in older adults: the life-cycle hypothesis and the permanent income hypothesis. The life-cycle hypothesis outlines specific periods in the life course when spending exceeds savings, i.e., in the borrowing phase of early adulthood and the post-retirement dissaving phase of late-life, and when income exceeds spending, i.e., during the middle-age working years.[62] Asset maximization typically occurs during late middle age, with accumulated wealth expected to help maintain standard of living in older age.[63]

The permanent income hypothesis posits that if persons who have an income change gauge this change to be permanent, they will reduce consumption to accommodate this change.[64] Because assessment of one's income is based both on current and future income, a person who has fewer assets may expect their standard of living to decrease after retirement. These persons will reduce consumption in the present, before the reduction in resources, to accommodate this perceived future change.

In older age, "maintaining a standard of living" often means devoting significant resources to health-related goods and services. This is particularly relevant for services and treatment not covered by Medicare. Long-term care is not covered by Medicare,[65] and is a significant part of expenditures for cognitive and physical disabilities. Those who have higher levels of wealth resources tend to have better health status and better health-related quality of life. Lower net worth has been found to be associated with higher levels of impairment following changes in cognitive and physical functioning,[66] as well as pain burden[67] and length of nursing home stay in the last year of life.[68]

Late Middle Age as a Potential Life Course Sensitive Period for Negative Wealth Shock

In a life course epidemiology approach, timing of causal actions is important to understand etiology and intervention points.[69] Sensitive periods are time periods in which an exposure has a greater effect on the risk of outcome as compared to other time periods in the life course.[70] Shocks to economic resources occur across the life course and, based on previous research, are likely to have deleterious effects on health at any age. However, we hypothesize that shocks to wealth in the late middle age period may be particularly deleterious to health, and thus late middle age may be a sensitive period to experience negative wealth shock.

Because persons in late middle age are usually nearing retirement, those who lose a substantial amount of accumulated wealth in late middle age have fewer income-generating years to replenish the lost wealth than those who lose wealth at earlier age periods in the life course.[71] This is exacerbated by social conditions: persons who lose their jobs during late middle age are less likely to regain the same level of employment[72] and those whose marital status changes are less likely to remarry.[73] Therefore, persons who experience a wealth shock in late middle age are more likely to have lasting changes in post-retirement wealth levels.

In accordance with the permanent income hypothesis, those who experience a dramatic loss of wealth may reduce their consumption of health-related goods and services in anticipation of reduced resources for retirement, even if current income remains stable. Forgoing medical care can lead to increased hospital admissions and premature mortality for existing chronic conditions,[74,75] as well as missed opportunities for screening and diagnosis of new conditions.[76] Furthermore, the stress of losing wealth so close to retirement, with the knowledge that this may permanently alter wealth trajectories and retirement plans, may also form an important pathway to health that is of particular importance in the late middle age period.

Limited previous evidence from ecologic studies suggests stronger associations between negative wealth shocks and suicide among those in late middle age. In US-based data, state-level foreclosure rates, state-level unemployment rates, and the recessionary time periods are associated with higher rates of suicide, with the largest increases for those aged 45-64.[26,28-29]

Because of the particular importance of maximizing wealth during late middle age and long-term changes in consumption and stress that may result from a loss of wealth, this dissertation specifically examines at negative shocks to *wealth* during the *late middle age* period.

1.4 Analytical Approach

There is debate over whether wealth shocks are causally related to poor health, or if they are merely a result of poor health. Poor health results in a loss of wealth,[77-79] and catastrophic medical expenses are the leading cause of bankruptcy in the US.[60] Previous research has addressed the potential for a bidirectional association between wealth loss and health by utilizing exogenous sources of economic loss, such as stock market volatility[47] or involuntary job loss.[80] These losses occur in response to macroeconomic conditions, and thus health conditions are unlikely to have triggered the wealth loss.

In this dissertation, we use design and analytic approaches that address the concerns about the potential bidirectional association between negative wealth shock and health that may not be sufficiently addressed by a standard regression approach. In the first aim, we use a crossover study design, which uses a within-person conditional regression model that adjusts by design for all observed and unobserved time-invariant characteristics that may confound the association between negative wealth shock and short-term changes in health.[81] In the second and third aim, we use a marginal structural model (MSM) approach to account for the confounding influence of time-varying health status prior to wealth shock without muting changes in health that may occur on the pathway from negative shock to long-term health outcomes.[82]

1.5 Specific Aims and Hypotheses

The purpose of this dissertation is to examine the short-term and long-term health consequences of negative wealth shock in nationally representative sample of US adults who are first followed in late middle age (50-64 years). Negative wealth shock is defined as a sudden loss of net worth, operationalized as the loss of a 75% or more in the monetary value of net worth.

The conceptual diagram in Figure 1.1 represents the two hypothesized pathways from negative wealth shock in late middle age to health declines in older age: (1) psychosocial changes related to perceived stress, and (2) reduced consumption of health-related goods and services due to perceived financial strain. Both the stress pathway and consumption pathway are hypothesized to result in short-term changes in health and well-being that lead to trajectories of poorer health in late-life, including faster cognitive decline, faster physical decline, and premature mortality. These late-life trajectories may be directly associated with the short-term changes in stress and consumption, or may be mediated by changes in health status and poor management of chronic conditions in mid-life or late-life. A better understanding of the mechanisms that connect negative wealth shock to health outcomes can be applied in developing targeted policies and interventions to reduce the health effects of negative wealth shock. The following specific aims and hypotheses will be evaluated in this dissertation:

Aim 1:

Determine whether experiencing a negative wealth shock is associated with short-term changes in depressive symptoms and medication adherence, consistent with the psychosocial stress and consumption pathways.

Hypothesis 1a: Persons will report higher levels of depressive symptoms after experiencing a wealth shock in late middle age (50-64 years) as compared to before the wealth shock

Hypothesis 1b: Persons will report higher levels of medication non-adherence after experiencing a wealth shock in late middle age (50-64 years) as compared to before the wealth shock.

Aim 2:

Determine whether persons who experience a negative wealth shock in late middle age have a differential all-cause mortality rate.

Hypothesis 2a: Persons who have experienced a wealth shock in late middle age will have a higher rate of all-cause mortality during follow-up as compared to persons who did not experience a wealth shock in late middle age.

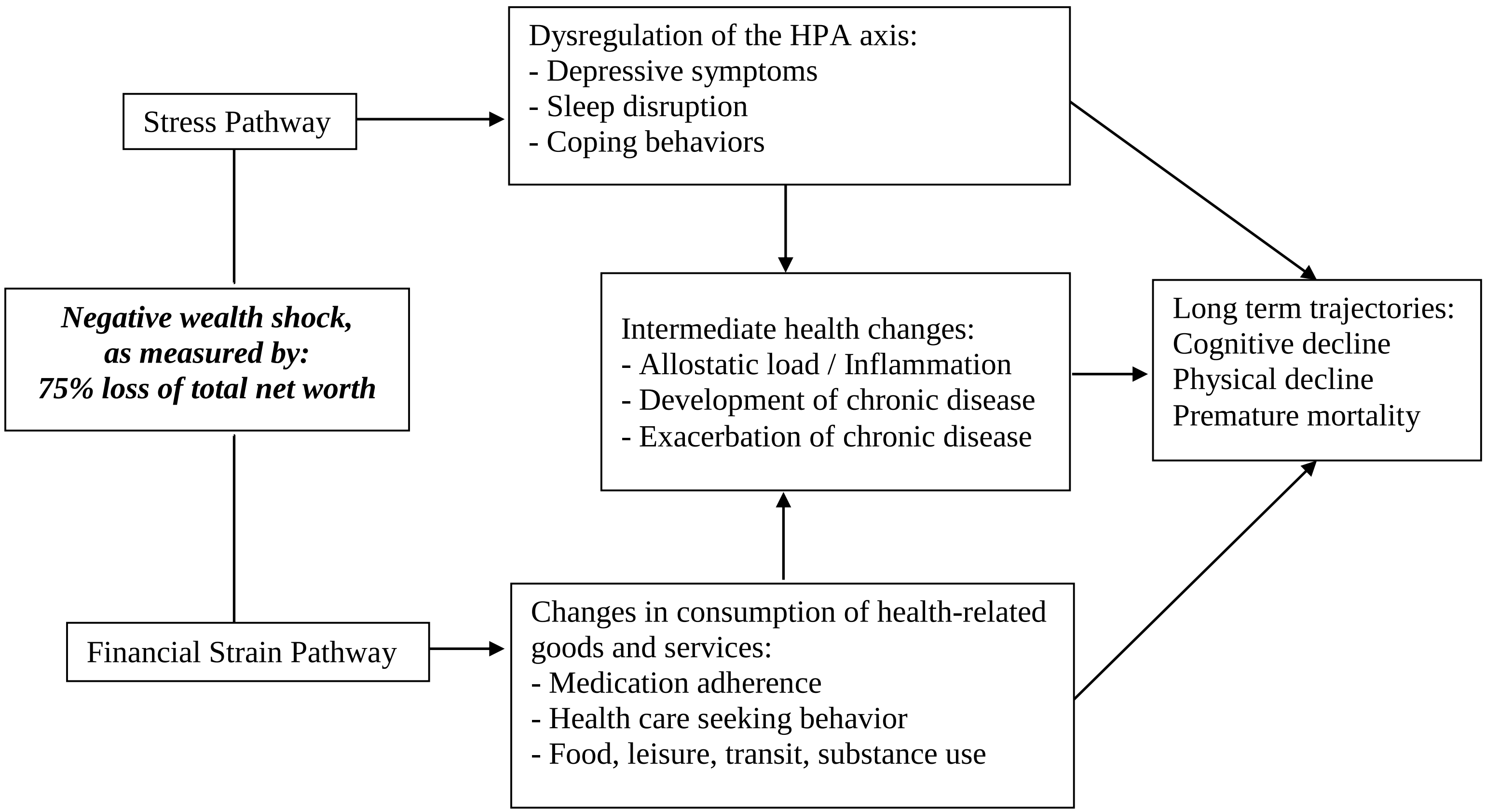
Aim 3:

Determine whether persons who experience a negative wealth shock in late middle age have a differential progression of cognitive and physical decline.

Hypothesis 3a: Persons who have experienced a wealth shock in late middle age will have a faster rate of cognitive decline as compared to persons who did not experience a wealth shock in late middle age.

Hypothesis 3b: Persons who have experienced a wealth shock in late middle age will have a faster rate of physical function limitation accumulation as compared to persons who did not experience a wealth shock in late middle age.

Figure 1.1 Conceptual Diagram Representing the Pathways from Negative Wealth Shock to Health Outcomes



Chapter 2

Measuring Negative Wealth Shock in the Health and Retirement Study

2.1 Data Source

The Health and Retirement Study (HRS) is a US-based national panel study of adults aged 50 and over.[83] HRS was designed to study factors influencing and resulting from retirement by collecting data on health, economics, labor force participation, and family structure of persons, starting in pre-retirement and following into retirement. The initial HRS cohort was recruited in 1992 using a multi-stage area probability sample designed to represent all non-institutionalized adults residing in the United States who were born from 1931-1941 (age 50-61 at time of study enrollment). Follow-up for HRS has been occurring biennially since 1992. The unit of observation is the household and spousal pairs were both recruited for entry into the study as long as at least one of the pair was age-eligible. Blacks, Hispanics, and persons residing in Florida were all oversampled to allow for analysis of these subgroups. Sampling weights derived from the Current Population Survey estimates of the US population are available to produce nationally representative estimates from analyses of the HRS data.

Beginning in 1998, as shown in Figure 2.1, additional birth cohorts were added to the study, including the Children of the Depression (CODA) cohort with birth years from 1924-1930 and the War Baby (WB) cohort with birth years from 1942-1947 (both added in 1998); the Early Baby Boomers (EBB) cohort with birth years from 1948-1953 (added in 2004); and the Mid Baby Boomers (MBB) cohort with birth years from 1954-1959 (added in 2010).[84] All cohorts are part of HRS and answer the same data collection questionnaires, but the "HRS cohort" refers to the original study participants with birth years from 1931-1941.

Because the survey modules are lengthy, questions related to housing, income, and wealth are asked of only one person in a spousal pair (the "financial respondent"). The data collected from these questions are ascribed to both members of the household. However, questions related to health and disability are asked individually of each participant.

The RAND Center for the Study of Aging has cleaned, processed, and documented comparability of variables across waves of HRS data collection. Household income, wealth, and health variables were imputed by RAND when appropriate, using model-based imputation techniques.[85] The resulting RAND HRS Data File (v.N) is a publicly-available subset of the HRS data, and will be the primary dataset used in these analyses. Variables not available in the RAND HRS file were pulled from the single year data files and appended to the RAND HRS file. Although HRS data collection continues, there were 11 waves of survey data available at the time of this dissertation (1992-2012).

2.2 Wealth Measurement in HRS

As studying the economics of retirement is a chief aim of the study, detailed questions about the value of assets and debts are measured in each wave of HRS. This dissertation uses the total net worth variable available in the RAND HRS data file, which is a sum of all wealth components assessed in the Assets section of the biennial questionnaire, minus all debts.[85] Table 2.1 lists the assets and debts included in this summary measure. With only minor changes in the wording of questions, the same set of wealth components is assessed in each wave of HRS data collection. Survey instruments from each wave are available on the HRS website: (http://hrsonline.isr.umich.edu).

The total wealth variable in the RAND file is imputed at the wealth component level. That is, if a participant stated that they own a particular asset but did not report the exact value of the asset or debt, the value of the asset or debt is imputed. If the participant is unwilling or unable to give an exact value, a series of questions was asked about whether the asset value falls within a particular range. This is known as an unfolding bracket method, and has been found to produce more valid and precise values than other imputation methods.[86] When available, these brackets are used in a nearest neighbor imputation approach. Otherwise, amounts are imputed with a Tobit approach using relevant covariates as well as cross-wave values of asset variables.[85]

Since 2002, HRS has included asset verification in the questionnaire to minimize cross-wave changes in net worth that may be due to reporting error rather than actual wealth loss. The verification occurs if the particular asset value has changed by at least $50,000 and total wealth has changed by at least $150,000. This strategy improves the validity of the data,[87] but reaches only the largest assets and wealthiest participants. From our analyses of the cross-wave wealth data in HRS, the majority of total wealth loss in HRS does not reach the $150,000 threshold.

HRS allows respondents to refuse participation within a given wave without being considered dropped from the sample.[88] At the next wave, attempts are made to interview these participants. It is only if a participant specifically asks not to be contacted again that they are considered dropped from the sample. Recontact response is high and missed waves of participation are common. If a respondent does not participate, all wealth variables are set to missing and no data is imputed.

2.3 Negative Wealth Shock Exposure Derivation

Negative Wealth Shock Exposure Operationalization

The main exposure of interest in this dissertation is a negative wealth shock experienced during late middle age (50-64). A negative wealth shock is broadly defined as a sudden loss of wealth, but there are currently no specific criteria or standards for determining whether negative wealth shock has occurred. Previous research has more frequently used home foreclosure,[43-45] bankruptcy,[51] retirement fraud,[52] or high levels of stock market holdings during a stock market crash[49,50] as indicators of negative wealth shock. Several studies have looked at percentage loss of wealth, but none have operationalized the loss in the same manner.[42,57,89]

For these analyses, negative wealth shock will be determined using a cut-point of percentage change in wealth between two consecutive biennial waves:

$$\% \text{ wealth change} = (\text{wealth}_t - \text{wealth}_{t-1}) / \text{wealth}_{t-1}$$

At a pre-set cut point of negative change, the exposure is dichotomized as whether a participant experiences negative wealth shock at time_t. Participants with any amount of positive wealth ($\text{wealth}_{t-1} > 0$) were considered at risk for negative wealth shock. Negative wealth shock is considered an absorbing state, so that in all analyses, a participant is considered "at risk" for the exposure until wealth shock occurs or – because of particular interest in wealth shock during late middle age – the participant reaches age 65. Because wealth values are missing for non-respondents, percentage wealth change cannot be calculated for participants who did not complete an interview in either of the two consecutive waves. Wealth shock status at time_t is marked as missing for these cases.

Negative Wealth Shock Dichotomous Cut-point Derivation

As there are currently no established criteria in the literature for a value that constitutes a negative wealth shock, we used methods commonly applied to diagnostic and predictive thresholds to choose an appropriate cut-point for negative wealth shock.

The aims of cut-point selection were two-fold. First, we wanted to avoid a cut-point that was low enough to permit significant misclassification. Despite the strengths of the measurement of wealth in HRS, including unfolding bracket imputation and asset verification, some level of variation in net worth between waves may be due to error in reporting of assets, rather than true loss of asset value. The second aim of the cut-point selection was to avoid a cut-point so high that statistical power would be jeopardized. In particular, the within-person conditional models in Chapter 3 require adequate number of exposed persons.

Using well-established predictors of wealth loss in late middle age, such as unemployment,[90] marital disruption,[91] and health conditions,[92] we fit several logistic regression models to determine the likelihood of a negative wealth shock at different percentages of negative wealth shock. Because negative wealth shock was defined using change in net worth between two consecutive waves, we constructed independent variables to model whether loss of income, new unemployment, change in marital status, and new health conditions predicted negative wealth shock. The models were additionally adjusted for demographics and socioeconomic status prior to negative wealth shock. The models were assessed for both overall sample size and predictive ability, using point estimates and goodness-of-fit measures.

Table 2.2 lists the regression coefficient estimates from these models. For a cut-point of 25%, the log odds of negative wealth shock are positively associated with asset levels prior to wealth shock, while for the 50%, 75%, and 100% cut-point models the log odds of negative wealth shock are negatively associated with prior asset levels. It is expected that those with lower wealth would be more likely to experience wealth shock, because the percentage of loss would constitute a lower dollar amount of loss. The positive association in the 25% cut-point model may reflect a higher likelihood for reporting errors and imputation among those with multiple assets.

Across the models, there are differing predictive abilities for the established predictors of negative wealth shock. New unemployment and lacking health insurance are universally predictive across the 4 models. Loss of income and marital disruption are more strongly predictive at 25%, 50%, and 75% shock levels. Health conditions are more predictive at the 100% shock level.

The goodness-of-fit statistics are listed in Table 2.3. Two overall performance statistics, a Brier score and Nagelkerke's R^2, were calculated. For the Brier score, a lower score approaching zero indicates better predictive performance of the model. Nagelkerke's R^2 is a pseudo-R^2 calculated for a logistic model, with a higher score indicating that the model explains more of the variation in the outcome. These performance statistics indicate the models become increasingly informative as the percentage cut-off increases, meaning that the established predictors of wealth loss are more reliably predicting higher levels of negative wealth shock. Likewise, the concordance (c) statistic, a measure of the model's ability to discriminate between those who did and did not experience wealth shock, increases as the percentage cut-off increases. A c-statistic higher than 0.7 is typically considered an adequately discriminated model.[93] Both the 75% and 100% cut-point models have a c-statistic in this range (0.73 and 0.78, respectively).

Finally, the number and the percentage of the total sample experiencing a negative wealth shock during late middle age is listed in Table 2.3. As the cut-point increases, number experiencing negative wealth shock decreases. The majority of the sample experienced a negative wealth shock of 25% or more during late middle age. This high prevalence is another indication that this particular cut-off may include participants misclassified due to reporting error.

Taking into account the ability to predict established wealth loss factors, the potential for misclassification, and sample size, we decided to use a 75% cut-point as dichotomizing value for the exposure in this analysis. While the 100% cut-point had a slightly better fit and discrimination, those performance gains were offset by the lower potential sample size.

2.4 Strengths and Limitations of the Negative Wealth Shock Measure

This analysis uses a 75% change in total wealth between two waves to assign negative wealth shock exposure. In longitudinal studies of health, it is rare to have frequent and comprehensive measures of wealth.[17] HRS data allow us to capture negative wealth shocks throughout late middle age, and examine short-term and long-term health consequences.

A strength of the negative wealth shock measure used in this dissertation is the use of total wealth, which captures a wide variety of wealth loss across socioeconomic and other demographic gradients. Previous research on negative wealth shocks have focused primarily on loss of a single asset, which limits inference those who own that specific asset. Economic research has shown differences in the asset types comprising household wealth by race and ethnicity; Non-Hispanic Blacks and Hispanics have lower levels of home and stock asset ownership than non-Hispanic Whites, even when controlling for educational attainment and income.[59] Furthermore, focusing on loss of a single asset differentially excludes persons who may spend down other assets and/or accumulate new debts in order to preserve another asset, such as their primary residence. Table 2.4 shows the percentage of asset value loss and debt gain among those who experienced negative wealth shock, by their level of wealth prior to the shock.

Despite these strengths, this measure is subject to several limitations. First, we did extensive testing to determine a negative wealth shock cut-off point that would allow for adequate sample size, but would limit the possibility of potential misclassification. Nevertheless, the 75% cut-off may include some individuals with random exposure misclassification. This type of misclassification biases results toward the null.[38] In Chapter 3, we include several tables of sensitivity analyses examining the results of the analysis by the various the percentage cut-points we considered. Though we determined the 75% cut-point *a priori*, these sensitivity analyses provide additional context. Additionally, we explored sensitivity analyses related to the exposure operationalization, including limiting those at-risk for negative wealth shock as having a minimum of $2,000 of wealth, excluding from the reference group those who have a positive wealth shock, and excluding all total wealth values that included imputed asset components. These sample exclusions did not qualitatively change effect estimates, but resulted in a loss of sample size, and thus, precision.

Because we use a percentage change in wealth, the absolute amount of wealth loss varies considerably by initial wealth levels. The potential health consequences of negative wealth shock may vary by amount of wealth loss, e.g., losing $7,500 could be less deleterious than losing $750,000. We explore this potential difference in Chapter 4.

Total wealth measured in HRS includes household wealth components, but does not include values of employer-based pensions, including defined contribution and defined benefit retirement funds. Likewise, Social Security wealth is important component of income stability for most older Americans, but we do not estimate Social Security wealth. We were primarily interested in assets that are liquid or could be liquidated to pay for living expenses in late middle age if needed.

Lastly, our measure of negative wealth shock required participants to have some level of measured wealth and to have longitudinal measurement of said wealth. We may fail to capture wealth shock that occurs during waves of non-response; this would lead to misclassification of wealth shocked persons as non-wealth shocked, and potentially bias results towards the null.[38] Additionally, we exclude from our sample anyone without zero or negative net worth at baseline. It is unknown whether these individuals had lifelong asset poverty or experienced a negative wealth shock prior to study entry; in both cases, they would not be at risk for a negative wealth shock during the follow-up period. Likewise, we excluded anyone from our sample who had no longitudinal measurement in HRS. This was due to death or drop-out after the first wave of data collection, as well as those whose participation in data collection was sporadic such that they never completed two consecutive interviews in late middle age. Using the original “HRS” cohort enrolled in 1992, Figure 2.2 lists the reasons and percentages for sample exclusion. Table 2.5 shows demographic differences between those with asset poverty at baseline, those without longitudinal measurement, and the entire original HRS cohort.

Figure 2.1 Year of Entry into the Health and Retirement Study by Birth Cohort[84]

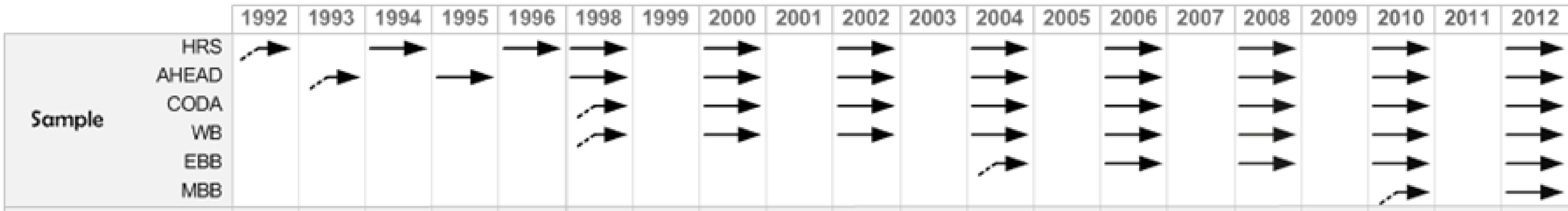


Table 2.1 Wealth Components Assessed in the Health and Retirement Study, 1992-2012

Assets
Value of primary residence
Net value of other real estate
Net value of vehicles
Net value of businesses
Net value of Individual Retirement (IRA) and Keogh accounts
Net value of stocks, mutual funds, and investment trusts
Value of checking, savings, or money market accounts
Value of Certificate of Deposits (CD), government savings bonds, and Treasury bills
Net value of bonds and bond funds
Net value of all other savings (e.g. money owed by others, valuable collections, annuities, or trusts)
Debts
Value of all mortgages/land contracts for primary residence
Value of other home loans for primary residence (e.g. home equity loans and lines of credit)
Value of other debt (e.g. credit card balances, medical debts, life insurance policy loans, personal loans)

Table 2.2 Logistic Regression Models Predicting Wealth Shock at Various Wealth Shock Percentage Cut-Offs for Late Middle Aged Participants in the Health and Retirement Study, 1994-2012

Predictor Variable [a]	25% Wealth Shock Model	50% Wealth Shock Model	75% Wealth Shock Model	100% Wealth Shock Model
	β	β	β	β
Total Assets [b]	0.052	-0.094	-0.276	-0.371
Loss of Income [c]	0.396	0.409	0.451	0.278
Newly Unemployed [c]	0.345	0.428	0.419	0.447
Newly Divorced [c]	1.025	1.219	1.176	0.619
Newly Widowed [c]	0.080	0.256	0.321	-0.056
New Chronic Condition [c]	0.087	0.108	0.146	0.235
New ADL Limitation [c]	0.256	0.280	0.433	0.452
Uninsured [c]	0.399	0.465	0.464	0.472

Abbreviations: ADL, activities of daily living.

[a] Models are additionally adjusted for gender, race/ethnicity, current age, age at study entry, income (calculated using Consumer Price Index-adjusted values for 2012-equivalent dollars, lagged, and modeled using log transformation).

[b] Asset levels are calculated using Consumer Price Index-adjusted values for 2012-equivalent dollars, lagged, and log transformed.

[c] Time period of measurement from $time_{t-1}$ to $time_t$.

Table 2.3 Goodness-of-Fit Measures of Wealth Shock Predictor Models at Various Wealth Shock Percentage Cut-Offs for Late Middle Aged Participants in the Health and Retirement Study, 1994-2012

Performance Measure	25% Wealth Shock Model	50% Wealth Shock Model	75% Wealth Shock Model	100% Wealth Shock Model
Overall Goodness-of-Fit				
Brier Score	0.19	0.11	0.06	0.03
R^2 (Nagelkerke)	0.05	0.07	0.12	0.13
Discrimination				
Concordance (c) statistic	0.62	0.66	0.73	0.78
Number (%) experiencing wealth shock	11,204 (58.1)	6,890 (35.7)	3,960 (20.5)	1,633 (8.5)

Table 2.4 Percentage of Negative Wealth Shocked Participants Losing Asset Value or Gaining Debts, by Type of Asset/Debt and Wealth Level Prior to Wealth Shock (N=3,960)

	Asset Value Loss / Debt Gain (%) [a]					
	Wealth Level $1 - $59,500 (n=2,376)		Wealth Level $59,501-176,000 (n=823)		Wealth Level >$176,000 (n=811)	
Assets	Some loss[b]	Total loss[c]	Some loss[b]	Total loss[c]	Some loss[b]	Total loss[c]
Primary residence	37	17	67	29	57	12
Other real estate	6	5	17	3	40	6
Vehicles	61	21	62	9	60	6
Businesses	3	3	12	9	35	25
IRA / Keogh	8	7	22	16	40	20
Stocks/investments	4	4	16	13	37	24
Bank accounts	48	20	60	15	58	11
Debts	Some gain	Total gain	Some gain	Total gain	Some gain	Total gain
Home equity loans	5	4	9	6	10	6
Unsecured debts	46	25	42	19	35	21

Abbreviations: IRA, individual retirement account.

[a] Only losses are reported for assets (primary residence, other real estate, vehicles, business, IRA/Keogh, stocks/investments, and bank accounts). Only gains are reported for debts (home equity loans and unsecured debts).

[b] Some loss/gain refers to the frequency of any amount of asset loss / debt gain that occurs with the negative wealth shock.

[c] Total loss/gain refers to the frequency of losing the entire asset or gaining a new source of debt that occurs with the negative wealth shock.

Figure 2.2 Analytical Sample Exclusions for Health and Retirement Study Cohort, 1992

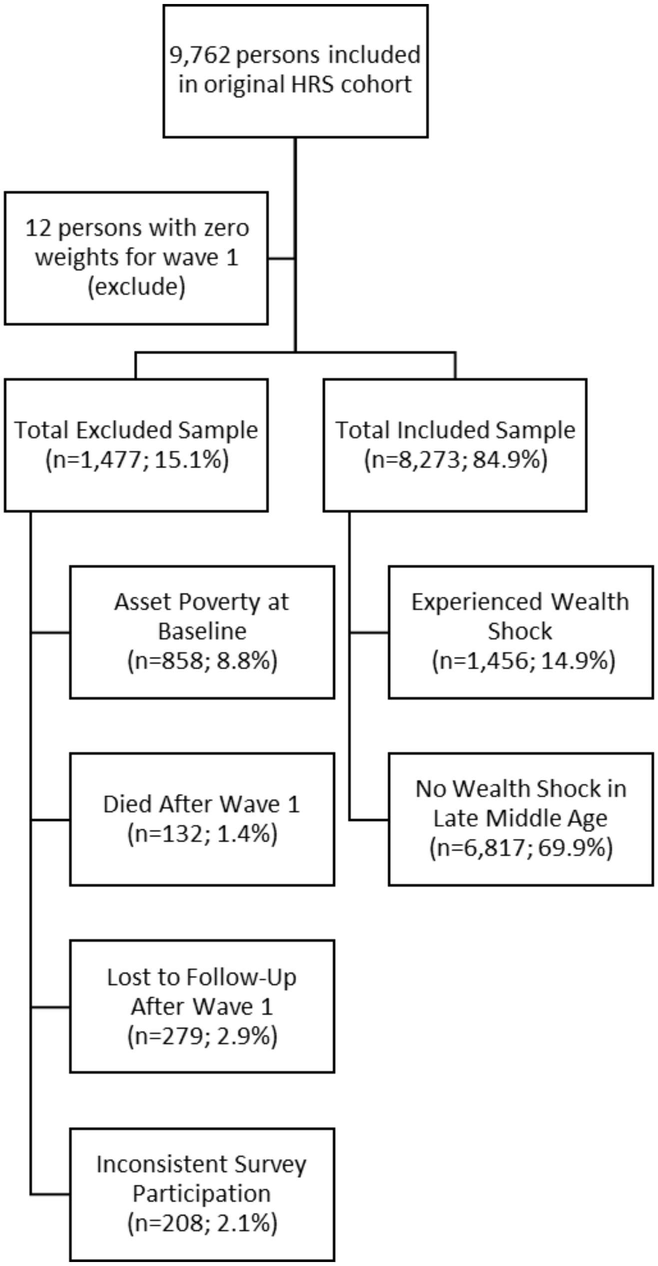


Table 2.5 Baseline Characteristics by Analytical Sample Exclusions, Weighted by Respondent-level Sample Weights, Health and Retirement Study, 1992

	Asset Poverty (n=858)	Other Exclusions (n=619)	Total HRS Sample (N=9,750)
Age in years, mean (SE)	55.2 (0.12)	56.1 (0.16)	55.6 (0.04)
Sex, %			
Female	59.8%	42.9%	47.6%
Male	40.2%	57.1%	52.4%
Race/Ethnicity, %			
Hispanic	16.2%	8.3%	6.4%
Non-Hispanic Black	33.7%	11.4%	10.1%
Non-Hispanic White	47.2%	75.9%	81.1%
Non-Hispanic Other	2.9%	4.4%	2.3%
Education, %			
Less than High School	53.3%	28.7%	25.2%
High School	27.8%	37.9%	36.6%
Some College	12.0%	16.1%	19.0%
College Degree or Higher	6.9%	17.3%	19.2%
Household Income, Median	$11,029	$30,953	$38,358
Household Net Worth, Median	$ -582	$100,480	$103,961
Employment Status, %			
Working	43.9%	63.5%	66.2%
Unemployed	8.2%	4.2%	3.1%
Retired	21.5%	18.3%	16.5%
Disabled	15.2%	5.1%	3.6%
Homemaker	11.2%	8.9%	10.6%
Health Insured, %	69.3%	80.2%	85.2%
Ever Smoked, %	73.6%	67.7%	63.9%
High Blood Pressure, %	47.5%	40.8%	32.5%
Diabetes, %	15.5%	11.6%	8.4%
Any ADL Disability, %	27.7%	14.2%	9.8%

Abbreviations: ADL, activities of daily living; SE, standard error.

Chapter 3

Negative Wealth Shock and Short-Term Changes in Depressive Symptoms and Medication Adherence Among Late Middle Aged Adults: A Nested Crossover Study

3.1 Background

Negative wealth shocks are large, sudden losses of net worth, resulting from rapid depletion of assets and/or accumulation of new debts. Individual-level wealth shocks can be triggered by both exogenous macroeconomic events, such as job loss due to recession,[90] or endogenous, personal events such as marital disruption[91] or major illness onset.[92] Previous research has shown links between specific recession-based shocks, such as loss of a house or stock market investments, and short-term changes in health. Studies that are limited to these exogenous shocks may not provide a complete estimate of the effects of negative wealth shock on population health, due to social patterning in home ownership and investment holdings,[59] high prevalence of endogenous shock triggers,[54,60] and population-wide effects on health during economic downturn.[28,30] Currently, the health consequences of negative shocks to total net worth remain unknown.

Much of the previous research on negative wealth shock is centered on the Great Recession of 2007-2009 and the shocks that characterized this time period: home foreclosure and investment losses.[22] Mental health outcomes, including increased risk of depression, anxiety, and psychological distress, are associated with home foreclosure[42-45,94] and investment loss.[49,50] Additionally, home foreclosure is associated with changes in health-related behaviors, including higher levels of medication non-adherence and forgoing needed medical care.[54] It is presumed that exogenous macroeconomic effects drive the negative wealth shocks in this research, which has the advantage of more straightforward causal interpretation with little potential for reverse causality and fewer potentially confounding variables.

Examining the health effects of negative shocks to total aggregate net worth spurred by both exogenous and endogenous circumstances may give a more complete understanding of the role of negative wealth shock in population health. However, causal inference difficulties are a warranted concern with an expanded wealth shock definition. Health complications are a substantial contributor to the overall prevalence of wealth shocks: in 2007, 62% of bankruptcies in the US were attributable to high medical debts.[60] It can be difficult to determine whether a negative wealth shock preceded a health shock, and even methods that attempt to control for reverse causality may still be limited by adjustment only for measured confounding variables, leaving the possibility of residual confounding. The association between negative wealth shock and health may be confounded by personal factors not routinely measured in epidemiologic studies that influence financial decision making, including biological and personality traits.[95,96]

To better isolate the causal effects of negative wealth shock, we conducted a nested crossover study using data from the longitudinal US-based Health and Retirement Study. Crossover studies are common in pharmacoepidemiology, and are being used increasingly in other analytical contexts.[81] This paired study design answers a different etiologic question that may better approximate causal effects; instead of estimating the exposure contrasts between individuals, the exposure contrasts are estimated within an individual's temporal variation.[97] The intrapersonal matching automatically controls for all non-time-varying characteristics, which greatly reduces the likelihood of unmeasured confounding and measures only new development of the outcome of interest.

This study examines the relationship between negative wealth shock and 2 outcomes: elevated depressive symptoms and cost-related medication non-adherence (CRN). We limit our sample to the late middle aged period (50-64 years), in recognition of the strong life course patterning of asset accumulation, which typically peaks in the late-middle age, near-retirement period. Previous research has suggested that health effects of wealth-related stress may differ by age group.[28,48] Results from the crossover study were compared with adjusted results from a more traditional between-person regression approach to examine whether the within-person analysis appears to adjust for residual confounding present that may be present in the between-person analysis.

3.2 Methods

Study Population

The Health and Retirement Study (HRS) is a longitudinal study of US adults aged 50 years and older. Detailed information on study design and content have been previously published.[83] Data from 11 biennial waves were used (1992-2012), obtained from the RAND HRS data set, version N.[85] Only HRS participants with longitudinal observation in late middle age (50-64 years) were eligible for this analysis (N=22,171). Eligible participants that did not have at least 2 consecutive net worth measurements during late middle age were excluded (N=231), as well as those with zero or negative net worth at baseline (N=2,659). The final analytical sample includes 19,281 participants. HRS was approved by the Institutional Review Board at the University of Michigan.

Outcome Variables

At each wave, participants were administered an 8-item Center for Epidemiologic Studies Depression Scale. Elevated depressive symptoms was defined as reporting at least 3 of the following symptoms for most/all of the time in the past week: responding “yes” to feeling depressed, everything is an effort, sleep is restless, feeling alone, feeling sad, cannot get going, and responding “no” to feeling happy and enjoying life.[98]

Beginning in wave 3, cost-related medication non-adherence (CRN) was assessed via a yes or no question that asked whether, within the last 2 years, participants had taken less medication than prescribed because of the cost.[99]

Negative Wealth Shock

A series of questions about household assets and debts were assessed at each wave of HRS. When multiple participants were part of one household, a single “financial respondent” answered wealth-related questions which were then ascribed to each member of the household. The net worth calculation summed all liquid and illiquid assets, including real estate, businesses, vehicles, stock holdings, bank account balances, and individual retirement accounts, and from this, subtracted all debts, including mortgage, other home equity loans, and unsecured debt. A negative change in net worth of 75% or more between 2 consecutive waves was considered a negative wealth shock, based on analyses to determine an appropriate cut-point (see Chapter 2 for additional detail). Negative wealth shock was dichotomized (yes/no) at each wave, and participants were considered at risk for a negative wealth shock until wealth shock occurred.

Covariates

Demographic covariates including gender (male/female), race/ethnicity (non-Hispanic White, non-Hispanic Black, Hispanic, non-Hispanic Other Race), and age were assessed at baseline. Educational attainment was assessed at baseline as a continuous variable representing number of years of education (range 0-18). Time-varying sociodemographic covariates were measured at each exposure wave, including marital status (coupled/non-coupled), household annual income (standardized to 2012 dollars using the Consumer Price Index and then log transformed), unemployment status (unemployed/other employment status), and health insurance status (insured/not insured). Additionally, we included 2 measures of health status, assessed at the wave prior to wealth shock exposure. History of 8 chronic conditions (yes/no) – hypertension, diabetes, cancer, chronic lung disease, heart disease, stroke, psychiatric problems, and arthritis – were summed as number of chronic conditions (range 0-8). Limitations in 5 activities of daily living (ADL) – walking across a room, getting in and out of bed, dressing, bathing, and eating – were dichotomized as any ADL limitations (yes/no), a marker of disability.

Statistical Analysis

In a crossover study, each participant undergoes outcome measurement at 2 time periods: an exposure period and an unexposed, control period. In traditional crossover studies, participants are assigned into either the exposure or the control period first and then subsequently "crossover" into the other period, often separated by a wash-out period to let residual therapeutic exposure effects diminish.[38]

Because the effects of negative wealth shock may not be restricted to the period immediately after exposure, we used a modified version of the crossover study in which all participants experienced the control period prior to the exposure period. In this study the "wash-out" period ensured discrete exposure and non-exposure periods, as determinants of negative wealth shock may already be operative prior to wealth shock itself with observable changes in health status. This design required participation in a minimum of 4 study waves, as illustrated in Figure 3.1. Therefore, the analytical sample for the crossover study was limited to those who had a negative wealth shock as well as 4 or more consecutive net worth measurements in late middle age. There were 3,960 participants in the full analytical sample that experienced negative wealth shock in late middle age. Of these, 1,192 (30.1%) met the requirement of 4 consecutive net worth ascertainments and formed the sample for the crossover analysis of elevated depressive symptoms. Because CRN was not assessed until wave 3 of HRS, the CRN crossover sample is slightly smaller (N=1,001; 25.3% of all wealth shocked participants).

Descriptive statistics for time-varying socioeconomic and health covariates were calculated for the 2 measurement periods in the crossover study. Bivariate associations for these time-varying measures were calculated using either the McNemar's test or the Wilcoxon signed rank sum test, for categorical and continuous variables, respectively.[38]

To test the adjusted association with negative wealth shock in the crossover study, we fit 2 models using conditional logistic regression,[93] separately for both elevated depressive symptoms and CRN. First, we tested the bivariate associations with negative wealth shock. Next, the models were refit, controlling for time-varying sociodemographic covariates and lagged health status covariates. The crossover study controls for all time-invariant covariates, which were not included in any of these models.

As a comparison model, we pooled data from each wave of the HRS. Participant data were included for all available waves in which they were in late middle age, responded to the survey, and were at risk for negative wealth shock (with no previous negative wealth shock). Negative wealth shock, using the change from previous wave's net worth, was ascertained in the same wave as elevated depressive symptoms and CRN. Between-person models assessing separately the association between negative wealth shock and both elevated depressive symptoms and CRN were fit controlling for the same time-varying sociodemographic and lagged health covariates as in the crossover study, as well as gender, race/ethnicity, educational attainment, and age. For this pooled analytical approach, we used generalized estimating equations to account for repeated measurement.[100]

The wealth-shocked participants who were in the nested crossover study represent a convenience sample of the total wealth shock participants. We conducted a sensitivity analysis to control for possible bias that may arise due to this non-random sample. A propensity score was calculated for each wealth shocked participant, based on a logistic regression model that predicted whether the participant was in the crossover study, using all covariates as independent predictors. We refit the pooled between-person model, applying standardized weights from the inverse of the propensity scores to balance the wealth shock exposure group by those who were and were not in the crossover study.[100] We also conducted a sensitivity analysis in which we limited the CRN models to those who reported regularly taking prescription medications, which produced similar estimates.

The survey weights available for HRS produce nationally representative prevalence estimates. Because this is an etiologic analysis to confirm a substantive hypothesis, survey weights were not used. The analysis parameters estimated have in-sample interpretations and should not be interpreted as US-population representative parameters.[8] All analyses were run using SAS 9.3 (SAS Institute, Cary, NC).

3.3 Results

Table 3.1 presents the baseline descriptive characteristics for the participants by experience of a negative wealth shock during follow-up and for participants included in the crossover study – a subsample of the wealth shocked participants. Of the 19,281 participants in the analysis sample, 3,960 experienced a negative wealth shock in late middle age (20.5%). As compared to individuals who did not experience a negative wealth shock in late middle age, those who experienced wealth shock were more likely to be female, non-Hispanic Black or Hispanic, and have lower levels of educational attainment. There were also some differences between the crossover subsample and the entire category of participants who experienced wealth shock; the subsample contained a higher percentage of female participants and a lower percentage of Hispanic and non-Hispanic Black respondents.

Table 3.2 shows the bivariate differences in sociodemographics and health status for the 2 exposure periods in the crossover study. Participants had significantly lower levels of household income and marriage/partnership, as well as significantly higher levels of chronic conditions, ADL limitations, and elevated depressive symptoms at the wave that negative wealth shock occurred, as compared to levels prior to the wealth shock. Health insurance coverage, unemployment, and CRN were not significantly different before and after experiencing negative wealth shock.

Results for the models examining the association between negative wealth shock and elevated depressive symptoms and CRN are listed in Tables 3.3 and 3.4, respectively. In the crossover model, a within-person analysis that controls for all time-invariant characteristics, negative wealth shock was associated with a 46% increase in the odds of elevated depressive symptoms (odds ratio (OR)=1.46; *P*=0.01), after further adjusting for time-varying sociodemographic characteristics and lagged health status. Negative wealth shock was associated with a 20% increase in the odds of CRN, but this fell below the level of conventional statistical significance (OR=1.20; P=0.42).

In the pooled model comparison analysis, after adjusting for time-varying sociodemographic and health variables as well as basic demographics, the odds of elevated depressive symptoms were 41% higher for persons who experienced negative wealth shock (OR=1.41; P<0.001) and the odds of CRN were 56% higher for persons who experienced negative wealth shock (OR=1.56; P<0.001), as compared to those who did not have a wealth shock. Refitting the models using the propensity score weight adjustment yielded results that were consistent if slightly elevated from the unweighted analysis for depression (OR=1.48; P<0.001) and consistent if slightly attenuated from the unweighted analysis for CRN (OR=1.50; P<0.001) (results not shown in the table).

3.4 Discussion

Using a crossover model that controlled for all time-invariant personal characteristics, this study found evidence for an association between negative wealth shock and elevated depressive symptoms, but no significant evidence for an association between negative wealth shock and CRN. Associations with negative wealth shock are possibly confounded by personal characteristics for which precise measurement is not routinely available, and the within-person crossover study design controls for any residual confounding due to unmeasured confounders that may be present in a more traditional between-person analysis. Risk of elevated depressive symptoms from crossover study models were similar in magnitude to models using between-person analytical methods, while risk of CRN varied dramatically from the within-person and between-person models, indicating a strong likelihood of residual confounding.

There are multiple hypothesized pathways from negative wealth shock to health. Negative wealth shock can be considered a stressful life event, because of the strain of both absolute financial loss[56] and loss of subjective social standing.[101,102] Stressful life events are an established risk factor for depression,[103] as stress can cause sustained activation of the hypothalamic–pituitary–adrenal axis, of which impaired mood is consequent.[104] Our results contribute to the sizable literature supporting this hypothesis.[105] In particular, these study results are in accordance with previous research on loss of specific components of wealth which has shown consistently elevated levels of depressive symptoms for negative shocks related to housing[42-45,94] and stock market loss.[49,50] By controlling for time-varying socioeconomic and health factors that commonly precede a negative wealth shock, such as marital disruption, unemployment, and serious illness, this study indicates that the wealth shock itself confers elevated risk of depression.

In an alternate pathway, it is hypothesized that a negative wealth shock would prompt reductions in health-related consumption, affecting medication adherence.[90] Incomplete adherence to prescribed medication is associated with long-term health consequences, including worsening of condition, increased comorbidity, and mortality.[106] Limited previous evidence showed significant associations between home foreclosure and CRN.[54] Our within-person analysis shows a non-significant association between negative wealth shock and CRN. CRN prevalence was higher in the crossover sample as compared to the entire HRS sample, but remained relatively stable before and after negative wealth shock. While we adjusted our models for insurance status, there may be nuances in type of insurance that may contribute to residual confounding in the between-person model. Underinsurance is common in late middle age,[107] especially prior to the implementation of the Affordable Care Act (ACA), and our insurance covariate did not capture coverage variation. Limited benefit policies increase risk of CRN and also increase risk of negative wealth shock due to other out-of-pocket healthcare costs.[108] More research is needed to understand the role of insurance in the wealth shock-CRN association, particularly after the implementation of ACA-mandated coverage standards.

We expand upon the current understanding of negative wealth shock by using total household net worth as the basis for wealth change. Previous research has focused almost exclusively on loss of a single asset, which limits inference to those who have the asset. Economic research has shown differences in the asset types comprising household wealth by race and ethnicity; Non-Hispanic Blacks and Hispanics have lower levels of home and stock asset ownership than non-Hispanic Whites, even when controlling for socioeconomic status.[59] Additionally, in the case of home ownership, persons may spend other assets and accumulate significant unsecured debts in an attempt to preserve their home.[109] These individuals could still have experienced a negative wealth shock without losing a particular asset.

By using a within-person design strategy over periods of varying macroeconomic stability, we can include wealth shocks due to multiple exogenous and endogenous triggers and provide a more generalizable estimate of the associations of negative wealth shock with population health. In our data, endogenous circumstances -- including health status -- were important contributors to these shocks. There is evidence that the generosity of state-level unemployment benefits may offset the adverse health effects of unemployment.[110,111] Further research should examine both personal and policy factors that may buffer the health risks of negative wealth shock, such as personal social support, social welfare policy, and access to medical charity care.

Use of HRS is an important strength of this analysis, as it is an ideal sample to study negative wealth shock during late middle age. HRS enrolls persons age 50 and older from a national sample that includes a broad representation of diverse populations. Over the 20 years of data collection, the HRS sample has been refreshed with additional cohorts, and thus all 11 waves of study data have observations for participants in late middle age. This affords adequate sample size, especially for a nested crossover study which by design only includes participants who experience negative wealth shock. Furthermore, standardized and repeated measures of net worth, depressive symptoms, and CRN were collected, facilitating valid cross-wave comparisons. HRS has detailed questions on a wide variety of assets and debts, and negative wealth shock can be directly ascertained from biennial measurements of detailed components of net worth.

Despite these strengths, this study is subject to several limitations. Because the crossover study required a specific exposure pattern, the sample size was confined to those who experienced wealth shock in a specific pattern. The crossover subsample is not a random sample of wealth shocked persons; persons included in the crossover subsample were more likely to be female and non-Hispanic White than the total negative wealth shock sample. We conducted a sensitivity analysis in which we applied propensity score weighting to the between-persons pooled model, accounting for the differing selection probabilities of being in the crossover study sample, and found little difference in results. However, the exposure pattern requirement can still affect statistical efficiency and power, which may contribute to the wider confidence intervals for the crossover study estimates. Additionally, we excluded from all models 2,659 persons who had zero or negative household net worth levels at baseline. Asset poverty has its own set of relationships with health outcomes that are beyond the scope of this analysis.[8,17]

This study was conceptualized to examine a dichotomized exposure, but there is no specific cut-off value previously validated in the literature as representing a negative wealth shock. We did extensive testing to determine a negative wealth shock cut-off point that would allow for adequate sample size, particularly in the crossover study, but would limit the possibility of potential misclassification. Despite these analyses, the 75% cut-off may include some individuals with random exposure misclassification, which would bias our results toward the null.[38]

Finally, we were particularly interested in the effects of negative wealth shock during the late middle age period, and thus inference is limited to this age group. In accordance with the life-cycle hypothesis – a well-known economic theory – asset accumulation has a strong age-related pattern, with net worth maximization expected to occur in the late middle age, near-retirement period.[62] We hypothesized that negative wealth shocks during this period may be more stressful than shocks during periods in the life course when expectations for saving are lower. Limited previous evidence suggests that negative wealth shocks may be more strongly associated with health outcomes in late middle age.[28,48] Future research replicating this analysis in both younger and older cohorts could explore late middle age as a potential sensitive period.

This study uses a nested crossover study to examine within-person effects of negative wealth shock. Our findings lend robust evidence for a causal association between negative wealth shock and elevated depressive symptoms, but do not find robust support for a causal association between negative wealth shock and CRN. Depression in midlife is an important risk factor for later-life cardiovascular disease,[112] dementia,[113] and disability,[114] and therefore, negative wealth shock during late middle age may be important determinant of health status in older age.

Figure 3.1 Design of Crossover Study Assessing Short-Term Changes Associated with Negative Wealth Shock

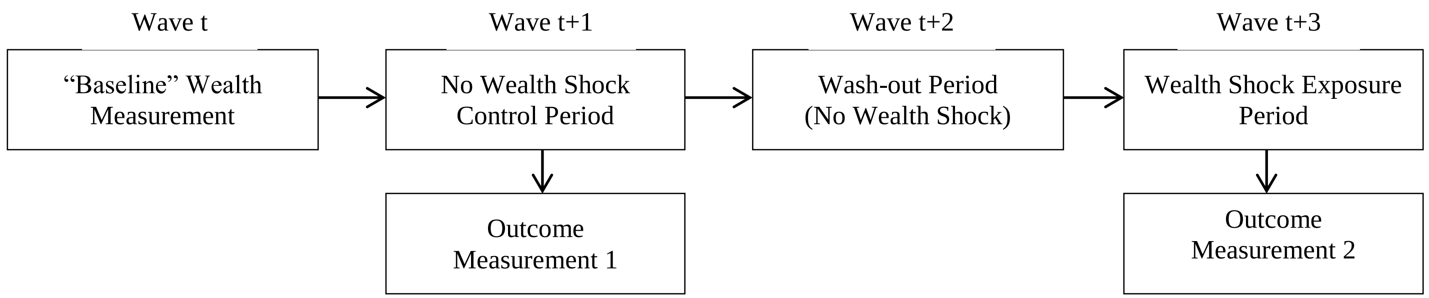


Table 3.1 Unweighted Baseline Characteristics of Late Middle Aged Participants (50-64) of the US Health and Retirement Study, 1992-2012.

	Wealth Shock Crossover Sample[a] (*n*=1,192)	Participants with Wealth Shock (*n*=3,960)	Participants without Wealth Shock (*n*=15,321)
Mean age, years (SD)	51.5 (3.5)	52.7 (4.2)	54.1 (4.2)
Sex, %			
Female	64.1	58.6	53.7
Male	35.9	41.4	46.3
Race/ethnicity, %			
Hispanic	11.0	16.5	9.8
Non-Hispanic Black	21.4	26.6	14.1
Non-Hispanic White	64.3	53.2	73.3
Non-Hispanic Other Race	3.3	3.7	2.8
Mean education, years (SD)	12.4 (3.0)	11.9 (3.4)	13.0 (3.0)

Abbreviation: SD, standard deviation.

[a] The crossover study sample is subsample of all participants with wealth shock (1,192 of 3,960 participants).

Table 3.2 Bivariate Associations of Demographic Characteristics and Health Status Before and After Wealth Shock Among 1,192 Crossover Study Sample Participants from the Health and Retirement Study, 1992-2012

	Pre-Wealth Shock Crossover Sample	Post-Wealth Shock Crossover Sample	Test Statistic[a] *P*-value
Median net worth, dollars[b]	100,915	5,250	<0.001
Median income, dollars[b]	56,835	41,655	<0.001
Married/partnered, %	75.4	64.7	<0.001
Unemployed, %	3.4	3.6	0.82
Insured, %	84.1	82.2	0.10
Mean chronic conditions (SD)[c]	1.2 (1.2)	1.6 (1.4)	<0.001
Any ADL limitation, % [c]	11.6	13.9	0.03
≥3 Depressive symptoms, %	25.3	32.4	<0.001
Cost-related medication non-adherence, %[d]	14.0	16.2	0.10

Abbreviations: ADL, activities of daily living; SD, standard deviation.
[a] McNemar's test used for categorical variables; Wilcoxon signed rank sum test used for continuous variables.
[b] Median net worth and income are calculated using Consumer Price Index-adjusted values for 2012-equivalent dollars.
[c] Mean number of chronic condition and whether any ADL limitations use lagged variables from the wave prior to the pre-wealth shock and post-wealth shock waves.
[d] Cost-related medication non-adherence assessment began in wave 3; prevalence calculated in reduced sample (*n*=1,001).

Table 3.3 Association Between Negative Wealth Shock and Elevated Depressive Symptoms by Analytical Strategy, Late Middle Aged Participants in the Health and Retirement Study, 1994-2012

Model	Crossover Study (*n*=1,192)		Pooled Study (*n*=19,281)	
	OR	95% CI	OR	95% CI
Model 1: Adjusted for Demographics [a]	1.84	1.45, 2.35	1.73	1.60, 1.86
Model 2: Adjusted for Demographics, Time-Varying Health and Socioeconomic Status [b]	1.46	1.08, 1.98	1.41	1.30, 1.52

Abbreviations: CI, confidence interval; OR, odds ratio.
[a] In the crossover study, Model 1is unadjusted by design. In the pooled study, Model 1 is adjusted for the following covariates: age, gender, race/ethnicity, educational attainment.
[b] Model 2 is adjusted for all Model 1 covariates, as well as time-varying income, unemployment, marital status, health insurance status, number of chronic conditions (lagged), whether any activities of daily living limitations (lagged).

Table 3.4 Association Between Negative Wealth Shock and Cost-Related Medication Non-Adherence by Analytical Strategy, Late Middle Aged Participants in the Health and Retirement Study, 1996-2012

Model	Crossover Study (*n*=1,001)		Pooled Study (*n*=17,530)	
	OR	95% CI	OR	95% CI
Model 1: Adjusted for Demographics [a]	1.28	0.95, 1.72	2.03	1.83, 2.24
Model 2: Adjusted for Demographics, Time-Varying Health and Socioeconomic Status [b]	1.20	0.78, 1.84	1.56	1.40, 1.74

Abbreviations: CI, confidence interval; OR, odds ratio.

[a] In the crossover study, Model 1 is unadjusted by design. In the pooled study, Model 1 is adjusted for the following covariates: age, gender, race/ethnicity, educational attainment.

[b] Model 2 is adjusted for all Model 1 covariates, as well as time-varying income, unemployment, marital status, health insurance status, number of chronic conditions (lagged), whether any activities of daily living limitations (lagged), elevated depressive symptoms (lagged).

3.5 Appendix: Sensitivity analysis for alternative negative wealth shock cut points

We conducted negative wealth shock dichotomous cut-point selection prior to performing the analyses in the crossover study and comparison pooled study. Because of the *a priori* selection of the 75% cut-point, we report those results in the main paper. As a sensitivity analysis, we refitted the fully adjusted models using the 25%, 50%, and 100% cut-points. We show the results of these models, along the 75% cut-point model results that were previously reported in the main manuscript, in Tables 3.A1 and 3.A2, for elevated depressive symptoms and CRN, respectively.

In the between-person pooled models, there is evidence of a dose-response effect. The odds of both elevated depressive symptoms and CNR associated with negative wealth shock increase monotonically as the percent cut-point increases. This monotonic trend does not hold for the crossover study. Odds of elevated depressive symptoms are highest at the 75% cut-point level, and odds of CRN at lowest at the 75% cut-point level, though CRN is non-significant for the 50%, 75%, and 100% cut-point levels.

Table 3.A1 Adjusted [a] Associations Between Negative Wealth Shock and Elevated Depressive Symptoms by Analytical Strategy and Level of Wealth Shock, Late Middle Aged Participants in the Health and Retirement Study, 1994-2012

Model	Crossover Study			Pooled Study		
	Sample size	OR	95% CI	Sample size	OR	95% CI
25% Wealth Shock Model	2,912	1.05	0.85, 1.29	19,281	1.13	1.07, 1.20
50% Wealth Shock Model	2,001	1.10	0.87, 1.40	19,281	1.25	1.17, 1.34
75% Wealth Shock Model [b]	**1,192**	**1.46**	**1.08, 1.98**	**19,281**	**1.41**	**1.30, 1.52**
100% Wealth Shock Model	540	1.33	0.84, 2.09	19,281	1.47	1.31, 1.65

Abbreviations: CI, confidence interval; OR, odds ratio.
[a] Adjusted for time-varying income, unemployment, marital status, health insurance status, number of chronic conditions (lagged), whether any activities of daily living limitations (lagged). Pooled study models are additionally adjusted for age, gender, race/ethnicity, educational attainment.
[b] Results reported in main paper.

Table 3.A2 Adjusted [a] Associations Between Negative Wealth Shock and Cost-Related Medication Non-Adherence by Analytical Strategy and Level of Wealth Shock, Late Middle Aged Participants in the Health and Retirement Study, 1996-2012

Model	Crossover Study			Pooled Study		
	Sample size	OR	95% CI	Sample size	OR	95% CI
25% Wealth Shock Model	2,257	1.41	1.02, 1.96	17,530	1.34	1.22, 1.46
50% Wealth Shock Model	1,658	1.34	0.93, 1.90	17,530	1.44	1.31, 1.58
75% Wealth Shock Model [b]	**1,001**	**1.20**	**0.78, 1.84**	**17,530**	**1.56**	**1.40, 1.74**
100% Wealth Shock Model	471	1.69	0.95, 3.00	17,530	1.95	1.68, 2.26

Abbreviations: CI, confidence interval; OR, odds ratio.
[a] Adjusted for time-varying income, unemployment, marital status, health insurance status, number of chronic conditions (lagged), whether any activities of daily living limitations (lagged), elevated depressive symptoms (lagged). Pooled study models are additionally adjusted for age, gender, race/ethnicity, educational attainment.
[b] Results reported in main paper.

Chapter 4

Negative Wealth Shock During Late Middle Age and All-Cause Mortality

4.1 Background

There is strong and enduring evidence for the social gradient in health, with substantially poorer health outcomes among people with lower socioeconomic status (SES). This gradient has been established for various components of SES, including income, education, and occupational status, and has been observed across a full range of health outcomes, such as mortality,[2,4] chronic conditions,[6,14,115] and mental health.[116] Another important component of SES is wealth; although more difficult to measure than other SES components, several studies suggest that the association of wealth with health is as robust as with other components of SES, particularly for middle-aged and older adults.[8,17]

More recently, there has been growing interest in determining the health effects of a sudden loss of wealth, or: a negative wealth shock. Negative wealth shock is usually a very stressful experience that may incur a significant mental health toll[57,58] and also leave fewer monetary resources for health-enhancing goods and services.[56] Some evidence suggests that negative wealth shocks are associated with short-term clinically relevant health changes, including increased risk of depression and anxiety,[42-45,49] suicide,[46,47] and substance use.[53,117] However, the degree to which negative wealth shocks have long-term effects on health outcomes remains mostly unknown.

Negative wealth shocks can be triggered by macroeconomic events that cause substantial increases in unemployment or significant stock market downturns, such as those that occurred in the wake of the Great Recession. They can also arise from personal circumstances, including major illness onset and resultant medical bills. Catastrophic medical debt is widespread in the United States, even among persons who are insured,[108] and is the most common reason for personal bankruptcy filings.[60] Due to the role of medical illness and associated debts in producing wealth losses, it is usually difficult to disentangle the impact of negative wealth shocks on subsequent health outcomes from that of poor health itself. Among those with existing chronic diseases, financial burden from out-of-pocket expenditures is associated with delaying future care[118] and poorer prognosis, including higher risk of hospitalization.[74,119]

In this study, we examined the association between negative wealth shock and all-cause mortality over 20 years of follow-up in a nationally representative population of late middle aged US adults. We focus on the age when life course wealth accumulation is usually at its peak and when there are relatively few years of gainful employment left to financially recover from negative wealth shocks.[71] Because adverse changes in health status at this age may both precipitate negative wealth shock and act as the mechanism for how negative wealth shock leads to increased mortality, we used a marginal structural statistical model that can account for the potential bias of time-varying health status beyond a simple control for baseline health status.

4.2 Methods

Study Population

The Health and Retirement Study (HRS) is a nationally representative longitudinal study of US adults aged 50 and older; we used the original HRS cohort, born 1931-1941, and for whom biennial data collection has been ongoing since 1992, to maximize potential follow-up time.[83] The most recent wave of available data is from 2012; all data were obtained from the RAND HRS file, version N.[85] The HRS was approved by the Institutional Review Board at the University of Michigan.

Of the 9,750 participants of the original HRS cohort, 619 (6.3%) were excluded because they did not have longitudinal measurement and thus we were unable to distinguish whether they experienced a negative wealth shock. Another 858 participants (8.8%) were excluded because they had zero or negative net worth at baseline. It is unknown whether these individuals had lifelong asset poverty or experienced a negative wealth shock prior to study entry; in both cases, they would not be at risk for a negative wealth shock during the follow-up period. The resulting analytical sample had 8,273 participants.

Negative Wealth Shock

Questions assessing the value of wealth components, including housing value, net value of businesses, individual retirement accounts, checking/savings accounts, certificates of deposits, savings bonds, investment holdings, net value of vehicles, and the value of any other substantial assets, were asked at each HRS interview. Debts subtracted from the asset total include home mortgages, other home equity loans, and unsecured debt values, like credit card balances, student loans, and medical debts. Differences in net worth between two consecutive interviews were used to calculate negative wealth shock: if a participant's household net worth dropped by 75% or more we considered them to have experienced a negative wealth shock (see Chapter 2 for more detail). We ascertained only wealth shocks that occurred during ages 50-64; persons were considered at risk for negative wealth shock until they experienced a wealth shock or reached age 65 (Figure 4.1).

Mortality

The outcome of interest was all-cause mortality. Deaths of HRS participants were assessed through three data sources: HRS exit interview of a family member, Social Security Death Index (SSDI) and the National Death Index (NDI). Familial notification data were augmented by the SSDI and NDI information. Nearly all deaths of HRS participants were captured through these sources.[120] In this study, mortality status was assessed at each survey wave; if a participant was reported by exit interview, SSDI, or NDI to have died prior to the survey wave, they were considered deceased at that wave and censored thereafter.

Covariables

Covariables for adjustment of multivariable models were chosen based on associations with both wealth loss and mortality as documented in the extant literature. All models were adjusted for the following baseline covariables: age at enrollment, sex, race/ethnicity (Black, White, Hispanic, or Other Race), educational attainment (in years), and tertile of household net worth. Time-varying socioeconomic variables measured at each survey wave included Consumer Price Index-adjusted household income, marital status, labor force status, and health insurance status. Time-varying health variables measured at each survey wave included past or current smoking, alcohol consumption, body mass index (kg/m^2), self-rated health, elevated depressive symptoms (3 or more of 8 Center for Epidemiologic Studies Depression Scale (CES-D) symptoms), any hospitalization in the past two years, 3 or more chronic conditions, and whether the participant had limitations in any of 5 activities of daily living (ADL) – walking across a room, getting in and out of bed, dressing, bathing, and eating. Additionally, we included a measure of baseline financial risk aversion (most averse/moderately averse/least averse) to adjust for personality differences that may influence selection into wealth shock and likelihood of engaging in higher-risk health behaviors.[121]

Statistical Analysis

The analyses were weighted to account for the complex survey sampling design of the HRS. Descriptive statistics display the distribution of demographic, socioeconomic, and clinical covariables at baseline in 1992. These descriptive statistics were stratified by negative wealth shock status, though at baseline none of the sample had yet experienced a measured negative wealth shock.

Hazard ratios estimating the association between negative wealth shock during late middle age and all-cause mortality were estimated using discrete-time hazard models to accommodate the biennial measurement of the outcome and covariables in HRS. Discrete time hazard models were fit via pooled logistic regression with a complementary log-log link, and the estimated odds ratio from these models is analogous to a hazard ratio as estimated by a Cox proportional hazard model.[122] The proportional hazards assumption was evaluated graphically and via an interaction term between negative wealth shock and time; there was no violation of the assumption.

We used a marginal structural model (MSM) covariable adjustment approach to account for the potential confounding due to time-varying changes in health and other variables that may precede negative wealth shocks during follow-up. Briefly, instead of entering time-varying covariables into the model as independent predictors of the mortality outcome, the model includes only the main predictor of interest – negative wealth shock – and baseline covariables. To account for the potential confounding of time-varying covariables, inverse probability of treatment weights (IPW) were calculated from separate models predicting the probability of not experiencing a wealth shock, given the covariables of interest at each time point.[82] These IPWs were then applied to the discrete-time models predicting the hazard of all-cause mortality, with negative wealth shock adjusted by these weights. To calculate the IPWs, two logistic regression models were fitted: (1) a numerator model predicting the probability of not experiencing a negative wealth shock as a function of the baseline covariables, and (2) a denominator model predicting the probability of not experiencing a negative wealth shock as a function of both baseline and time-varying covariables of interest. The numerator probability was divided by the denominator probability, resulting in a "stabilized" IPW.[123] To account for the complex survey sampling of the HRS, HRS sampling weights were multiplied by the IPW to create a final adjustment weight.[124] Further details on the MSM approach are in the Appendix.

Adjusted survival plots were calculated using time since wealth shock with IPW adjustment.[125] Interaction terms between negative wealth shock and baseline net worth tertile, race/ethnicity, and gender were used to test for potential effect modification. All analyses used SAS 9.3 (SAS Institute, Cary, NC).

4.3 Results

Among the 8,273 participants in the analytical sample, 1,456 experienced negative wealth shock during late middle age. When weighted to account for the complex survey design of HRS, this is equivalent to 16.0% of the late middle-aged US population. As compared to those who did not experience a negative wealth shock during late middle age, those who did were more likely to be female, non-white race/ethnicity, and have lower levels of socioeconomic indicators, including educational attainment, household income, household net worth, working for pay, and married/partnered (Table 4.1). Likewise, those who experienced a negative wealth shock had more high-risk health indicators at baseline including current smoking, heavy alcohol use, less health insurance coverage, lower self-rated health, more chronic conditions, and more ADL disability. Additionally, there were lower levels of financial risk aversion in those who experienced negative wealth shock.

A total of 2,196 participants died across an average follow-up of 17.6 years. Those who experienced negative wealth shock were significantly more likely to die during follow-up: 32.4% versus 24.2% (P<0.001). After adjusting for baseline and time-varying covariables using the MSM approach, the mortality rate remained significantly elevated for those who experienced a negative wealth shock (HR: 1.37, 94% CI 1.20-1.56) (Table 4.2). In a non-MSM conventional model adjusted for baseline and time-varying covariables, negative wealth shock in late middle age was associated with only a 22% higher mortality rate (95% CI 1.05-1.42). Adjusted survival curves in Figure 4.2 graphically display the mortality rate differences between those who did and did not experience a negative wealth shock, using the MSM approach.

We also explored the possibility of differential effects on mortality by level of wealth at baseline (Figure 4.3). The interaction term between negative wealth shock and tertile of baseline net worth was not significant (P=0.92). Effect modification by race/ethnicity and gender also proved non-significant, (P=0.30 and P=0.37, respectively).

4.4 Discussion

In a nationally representative sample of US adults, we found that 16% experienced a negative shock of 75% or more of their net worth during the late middle age period between the years 1992 and2006. Those who experienced a negative wealth shock had a 37% greater mortality rate during follow-up as compared with those who remained shock-free before retirement. Previous research has provided robust evidence for the link between lower socioeconomic status and risk for adverse health outcomes. Our findings suggest that, in addition to enduring patterns of economic hardship leading to poor health outcomes,[3] a sudden loss of economic standing in late middle age may also have deleterious and long-term consequences for health. Our findings were robust to the influence of changes in health and other factors that may be related to both the likelihood of experiencing negative wealth shock in late middle age and risk of mortality. Negative wealth shocks may be another critical and so far largely-overlooked component of the social determinants of health among middle-aged adults in the US population.

We used 75% or more change in net worth to define the negative wealth shock exposure, so the absolute amount of loss in wealth varied considerably by individuals' initial wealth levels. To determine whether these differing baseline net worth levels may modify the association with all-cause mortality, we included an interaction term between negative wealth shock and baseline level of net worth. Despite the dollar amount differences, negative wealth shock was associated with an elevated hazard of mortality across levels of net worth. This may be due to the universal influence of two distinct but related pathways from negative wealth shock to mortality: decline in economic resources and psychosocial toll of loss.

Declining financial resources and concerns about paying medical bills can result in reduced spending on health-related goods and services, including delaying or forgoing needed medical care and prescription medications.[99] In turn, delaying needed medical care and incomplete adherence to prescribed medication are associated with long-term health consequences, including increased hospitalization and mortality.[74,119] Perceived financial strain is not perfectly correlated with objective indicators of financial status.[126] For this reason, persons who experience negative wealth shock may reduce consumption of needed medical care, even if they still have the ability to afford care after wealth shock.[127] There may be opportunities for clinicians to identify financial barriers that could be addressed through connecting patients with lower-cost treatment regimens and other financial assistance.

An additional pathway from negative wealth shock to all-cause mortality is through the psychosocial toll of loss. There are different domains of potential psychosocial changes that occur in response to negative wealth shock, including reduced social participation and loss of social relationships, loss of a sense of control, increased feelings of stigmatization, change in subjective social standing, as well as the acute stress of a negative life event.[56-58] Previous research has shown higher risk of mental health conditions, suicide, and substance abuse after experiencing a negative wealth shock.[42-47,49,53,117] It is generally presumed that psychosocial changes mediate this pathway, even if pre-existing financial and social resources potentially buffer some of these effects.[56,57] More research is needed to understand how both public and personal resources might be deployed to reduce the elevated risk of mortality due to negative wealth shock.

Use of the Health and Retirement Study data is a strength of this study. First, the HRS is nationally representative study population, which makes our results generalizable to the entire late middle-aged population in the US. Second, it includes repeated assessment of net worth at two-year intervals during follow-up. Net worth is usually difficult to ascertain and subject to substantial recall bias.[128] Because characterizing the economics of retirement is a chief aim of HRS, net worth ascertainment is detailed and standardized across waves, with an unfolding bracket imputation approach to provide additional stability across estimates.[86] We rely on this stability to ensure that our measure of negative wealth shock captures true loss of net worth and minimizes misclassification from reporting errors. We use the original HRS cohort, enrolled in

1992 and followed for all-cause mortality for up to 18 years. The lengthy follow-up period captures both proximal mortality, such as suicide, as well as sustained, long-term mortality risk. Risk of suicide has been shown to be elevated in previous studies of negative wealth shock,[46,47] but the long-term consequences of negative wealth shock are mostly unknown. Finally, we used a statistical model specifically designed to account for the relationship between health changes and likelihood of negative wealth shocks during follow-up, which may introduce substantial bias in the observed relationship between negative wealth shocks and mortality if estimated through conventional regression models.

There are also a number of potential limitations to consider when interpreting these findings. First, in order to maximize follow-up time for all-cause mortality, we used a cohort that had reached age 65 by 2006. Thus, our follow-up time for negative wealth shocks does not include losses that occurred in the Great Recession. Instead, negative wealth shock exposure ascertainment occurred primarily in the 1990s, which was the longest period of economic growth in US history.[129] There is some evidence that the overall population mortality rate increases during periods of macroeconomic growth.[130] Likewise, there is some evidence that the overall population mortality rate declines during economic downturn, except among those personally experiencing negative effects of the recession, such as sustained unemployment, who have an increased risk of mortality.[40,41] Due to this contrast, the differences in mortality between those who do or do not experience negative wealth shock may be more stark during economic downturn. Our results may reflect a conservative estimate of the overall association between negative wealth shock and mortality hazard that may be an underestimate for birth cohorts experiencing macroeconomic economic downturn during late middle age.

The follow-up time for negative wealth shocks also occurs prior to the implementation of the Affordable Care Act (ACA). One of the intentions of the ACA is to limit catastrophic medical expenses through increased insurance coverage and annual out-of-pocket cost maximums.[108] Lack of health insurance coverage was a strong predictor of negative wealth shock in our analysis. At baseline, 26.1% of the sample who would later experience a negative wealth shock were uninsured, as compared to 10.8% who did not experience wealth shock. National estimates of the percentage of US adults who are uninsured has fallen since 2010, when the first provisions of the ACA were implemented.[131] Future research should evaluate whether the increases in health care coverage have contributed to lower levels of negative wealth shock. However, wealth shocks not triggered by medical expenses would persist, and excess hazard of mortality could remain from these shocks. Other social programs, like unemployment insurance, may buffer some of the deleterious health consequences of negative wealth shock.[110]

Our findings in a nationally representative population of late middle-aged adults suggest that a loss of at least 75% in net worth is associated with a nearly 40% increase in all-cause mortality. This risk was not restricted to the immediate aftermath of the wealth shock, but remained elevated for a period up to 20 years, as indicated by the proportional hazards model. The findings provide the first evidence for the serious and long-term health consequences of experiencing a substantial loss of wealth in late middle age. The results will add to our understanding of the adverse health effects of economic hardship. It is likely that a combination of increased clinician awareness and targeted social programs will be needed to potentially alleviate the health consequences of negative wealth shocks in late middle age.

Figure 4.1 Negative Wealth Shock Exposure Measurement Design

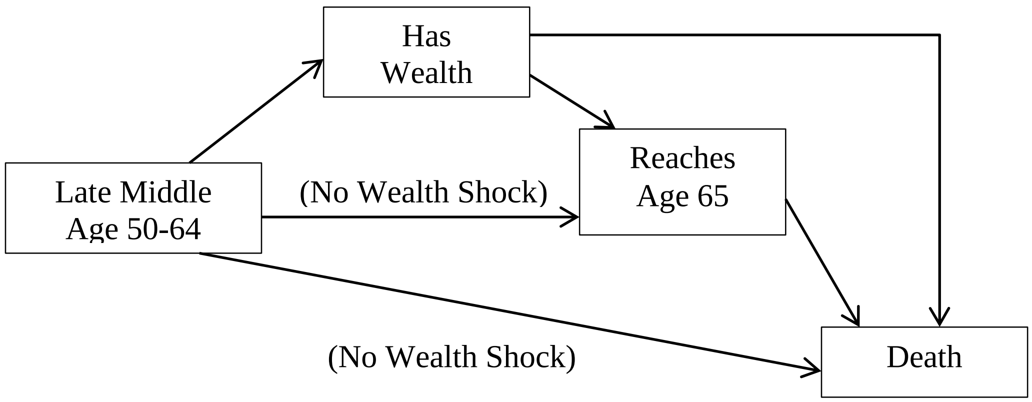


Table 4.1 Baseline Characteristics by Negative Wealth Shock During Late Middle Age, Weighted by Respondent-level Sample Weights, Health and Retirement Study (N=8,273)

	Participants without Wealth Shock (n=6,817)	Participants with Wealth Shock (n=1,456)
Age in years, mean (SE)	55.8 (0.04)	54.3 (0.10)
Sex, %		
Female	51.9%	55.5%
Male	48.1%	44.5%
Race/Ethnicity, %		
Hispanic	4.5%	10.7%
Non-Hispanic Black	6.6%	16.4%
Non-Hispanic White	86.9%	69.7%
Non-Hispanic Other Race	1.9%	3.2%
Education, %		
Less than High School	20.0%	36.6%
High School	38.4%	31.4%
Some College	20.2%	17.2%
College Degree or Higher	21.4%	14.8%
Household Income, Median	$43,800	$26,479
Household Net Worth, Median	$134,979	$36,182
Net Worth Tertile, %		
$1-$59,500	23.6%	60.3%
$59,501 – $176,000	35.4%	21.6%
>$176,000	41.0%	18.1%
Marital Status		
Married/Partnered	82.0%	68.0%
Divorced/Separated	10.4%	19.4%
Widowed	4.8%	7.7%
Never Married	2.9%	4.9%

Table 4.1 Baseline Characteristics by Negative Wealth Shock During Late Middle Age, Weighted by Respondent-level Sample Weights, Health and Retirement Study (N=8,273)

	Participants without Wealth Shock (n=6,817)	Participants with Wealth Shock (n=1,456)
Employment Status, %		
Working	69.1%	63.5%
Unemployed	2.2%	4.5%
Retired	16.5%	13.1%
Disabled	1.8%	6.5%
Homemaker	10.3%	12.3%
Health Insurance, %	89.2%	73.9%
Body Mass Index, mean (SE)	26.8 (0.07)	27.5 (0.17)
Alcohol Use, %		
None	33.5%	44.0%
Moderate (1-2 daily drinks)	61.6%	50.2%
Heavy (3 or more daily drinks)	4.9%	5.8%
Ever Smoked, %	62.1%	66.9%
Self-Rated Health Status, %		
Excellent	26.0%	20.6%
Very Good	32.9%	23.7%
Good	26.1%	27.1%
Fair	10.4%	18.5%
Poor	4.6%	10.1%
# Chronic conditions, mean (SE)	0.9 (0.02)	1.1 (0.04)
Any ADL Disability, %	7.0%	13.5%
Financial Risk Aversion, %		
Least risk averse	11.6%	15.1%
Moderately risk averse	22.3%	25.8%
Most risk averse	66.1%	59.1%

Abbreviations: ADL, activities of daily living; SE, standard error.

Table 4.2 Adjusted Hazard Ratios by Modeling Approach for Associations Between Negative Wealth Shock During Late Middle Age and All-Cause Mortality, Health and Retirement Study

	Baseline-Adjusted Model	Marginal Structural Model	Conventional Model
	Hazard Ratio (95% CI)	Hazard Ratio (95% CI)	Hazard Ratio (95% CI)
Negative Wealth Shock	1.75 (1.55-1.98)	1.37 (1.20-1.56)	1.22 (1.05-1.42)

Abbreviation: ADL, activities of daily living; CI, confidence interval.
[a] All models are adjusted for the following baseline covariables: age, gender, race/ethnicity, educational attainment, financial risk averseness, net worth tertile. Marginal structural and conventional models are also adjusted for the following time-varying covariables: household income, marital status, labor force status, health insurance status, smoking status, alcohol use, body mass index, self-rated health, elevated depressive symptoms, whether hospitalized in past 2 years, multimorbidity (3+ chronic conditions), and whether any ADL limitations.

Figure 4.2 Adjusted Survival Curves of All-Cause Mortality During Follow-Up by Negative Wealth Shock During Late Middle Age, Health and Retirement Study

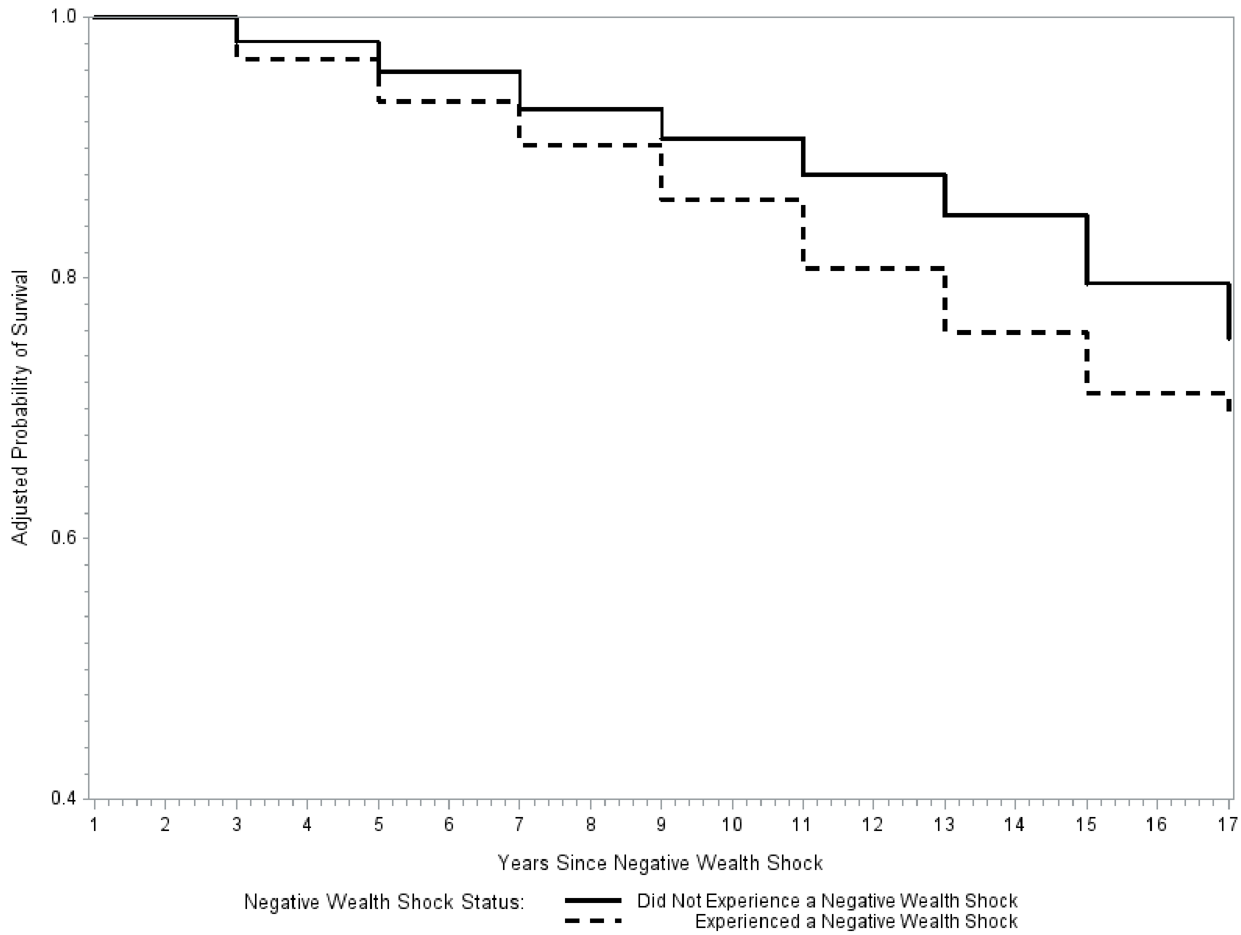
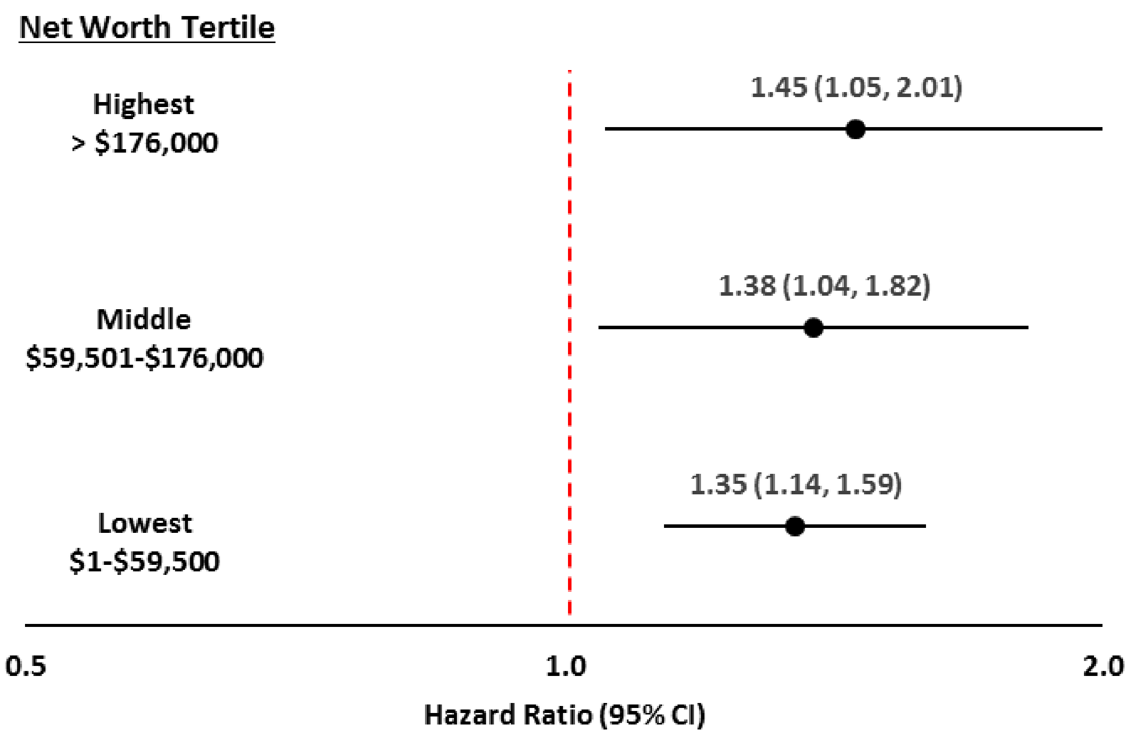


Figure 4.3 Adjusted Hazard Ratios by Tertile of Net Worth for Associations Between Negative Wealth Shock During Late Middle Age and All-Cause Mortality



4.5 Appendix: Details on Marginal Structural Modelling Approach

Overview

When a time-dependent exposure is influenced by time-dependent covariates that act simultaneously as confounders and intermediate variables, adjustment using standard multivariable methods will lead to overadjustment of estimates and bias toward the null.[38] A covariate is considered an endogenous, time-varying confounder of the exposure-outcome relationship if past covariate values predict current exposure and current covariate value predicts the outcome. Marginal structural models (MSMs) were developed to account for time-varying confounding by modeling the marginal distribution of the covariates through inverse probability weights (IPWs) that balance the exposure groups at each follow-up period.[82] These weights create a "pseudopopulation" that is unconfounded by the measured covariates and in which censoring does not exist.[123] Even in the absence of endogenous confounders, controlling for confounding via inverse probability weighting will yield valid model estimates. However, the trade-off is reduced precision as compared to a conditional modeling approach. Therefore, in order for MSMs to be useful, it must be established that the covariates of interest can be both confounders and mediators in the causal pathway between the exposure and the outcome.[132]

Justification of the MSM Approach

In the example of wealth shock in late middle age and subsequent risk of mortality, time-varying health status is hypothesized to have both a confounding and mediating role. In the hypothesized causal diagram, (Figure 4.A1), wealth shock is assumed to be influenced by health at each time point, and then influences health at future time points. Four preconditions should be satisfied to justify the use of the MSM approach.[133] The satisfying of the preconditions is for the association between negative wealth shock and all-cause mortality is explained in Table 4.A1.

Further Model Considerations

Marginal structural models were developed for measurement of time-varying exposure and covariates throughout the duration of follow-up. Yet, by design, this analysis measures only wealth shock and covariates during the late middle age range (50-64 years) while the mortality end point will be assessed over a more extended period of time (Figure 4.1). As a result, this analysis uses a modified form of MSMs that adjusts for time-varying covariates in a given person only through late middle age.[135] The implementation of this particular form of MSMs uses different formulae in the calculation of stabilized inverse probability weights that account for the exposure process only until the chosen time point in the covariate weights.

Estimation of the Inverse Probability Weights

The inverse probability weight (IPW) is proportional to the inverse of the probability of having the observed exposure through that follow-up wave, for each participant *i* and wave *t*, among those who are late middle aged (50-65 years), alive, completed an interview, and have not yet experienced a negative wealth shock. To calculate these weights, two pooled logistic models were fitted to output the probability of not experiencing a wealth shock by participant ID and follow-up wave. The first model (the numerator model) includes only baseline covariates, while the second model (the denominator model) includes both baseline and time-varying covariates. Models were fitted in using the SAS SURVEYLOGISTIC procedure to account for the complex survey sampling design of HRS.[124]

Numerator probability model:

$$logit(\Pr[A_k = 0 \mid \overline{A}_{k-1}, \overline{G}_k = 0, L_0]) = \alpha_{0k} + \alpha_1 L_0$$

Denominator probability model:

$$logit(\Pr[A_k = 0 \mid \overline{A}_{k-1}, \overline{G}_k = 0, \overline{L}_k]) = \alpha_{0k} + \alpha_1 L_k$$

where

- A_k represents the exposure to wealth shock at time *k*
- $\overline{A}_{k-1}$ represents the history of exposure to wealth shock
- $\overline{G}_k$ equals 0 if the participant is alive and age is <65 years at time *k*, and equals 1 if the participant has been censored due to age, death, or other
- L_0 represents baseline covariates
- L_k represents baseline and time-varying covariates at time *k*
- $\overline{L}_k$ represents baseline and time-varying covariates up to time *k*

To calculate the IPW, predicted probabilities from the numerator model are divided by the predicted probabilities from the denominator model. This provides a "stabilized" weight (SW^E) for each person *i*.

IPW Calculation Formula:

$$SW_i^E(t, S_t) = \prod_{k=1}^{S_t} \frac{pr(A_k|\overline{A}_{k-1}, \overline{G}_k = 0, L_0)}{pr(A_k|\overline{A}_{k-1}, \overline{G}_k = 0, \overline{L}_k)}$$

where

- S_t represents the number of time intervals that participant *i* is in late middle age

Correct calculation of the IPW requires that several marginal structural model assumptions be met: consistency, exchangeability, positivity, and no misspecification of the model used to estimate the weights. Consistency, in which the counterfactual outcome is equal to the observed outcome, and exchangeability, in which there is no unmeasured confounding, are not empirically verifiable.[136] We attempt to meet these assumptions by including as covariates the common predictors of negative wealth shock, as well as demographic and personality characteristics associated with wealth shock.

Positivity and misspecification of the IPW models can be tested. Positivity exists when there are exposed and unexposed individuals for each level of the covariates. Structural zeros indicate that an exposed (or unexposed) person cannot have some level of a covariate because of a systematic difference, while random zeros occur when empty cells occur because a covariate is rare or has many levels.[136] Contingency tables (categorical variables) and boxplots (continuous variables) were used to assess positivity violations in this analysis. For covariates in which positivity might be violated, variables were recoded into fewer categories. For example, a variable assessing whether a participant had 0-8 common chronic conditions had positivity violations at the upper levels of the variable. To address this positivity issue, we recoded this variable by whether the participant had 3 or more chronic conditions, an indicator for multimorbidity.

To determine whether the IPW models were misspecified, we tested a series of possible confounders, checking the mean of the estimated weights, as well as the standard deviation, minimum, and maximum. Weights that deviate substantially from 1.0 indicate nonpositivity or misspecification of the model, though the magnitude of the weight typically increases with the number of time points.[136] Covariates were included if they added to the overall model fit, without inducing a large deviation from the mean of 1. Table 4.A2 shows the overall IPW. Table 4.A3 lists the final IPW weight distribution by year.

Baseline covariates: Age at baseline, Gender, Race/ethnicity, Educational Attainment(years), Risk Averse, Net Worth Tertile

Time-varying covariates: Household Income (logged and CPI adjusted), Marital Status, Labor Force Status, Insurance Status, Smoking Status, Alcohol Use, BMI, Self-Rated Health, Elevated Depressive Symptoms, Hospitalized in Last 2 Years, Multimorbidity (3+ chronic conditions), Any ADL Limitation

Specification of the Structural Model

To produce estimates in the unconfounded pseudopopulation, the structural model applies a final MSM weight, which is the product of the IPW weight and the HRS survey weight.[124] A discrete time hazard model estimates the association between negative wealth shock during late middle age and all-cause mortality. Use of a complementary log-log (clog-log) link in the discrete time hazard model provides an estimate that is analogous to a hazard ratio estimated by a Cox proportion hazard model.[122] The person-time scale use is time on treatment (wealth shock), as compared to time on study.[125] While baseline covariates are used in constructing the inverse probability weights, they are also included in the structural model to control for any extraneous confounding.[82] Baseline covariates in the final model include: year, age, gender, race/ethnicity, educational attainment, financial risk-averseness, and net worth tertile. Interactions with the negative wealth shock exposure, including tests for effect modification by race/ethnicity, gender, and baseline net worth tertile, are also fit in the final structural model.

Modeling Equation

$$logit(\Pr[D_t = 1 \mid D_{t-1} = 0, \overline{A}_{t-1}, L_0]) = \beta_{0t} + \beta_1 A_{t-1} + \beta_2 L_0$$

where

- D_t equals 1 if the participant died by wave *t* and equals 0 if the participant was still alive
- $\overline{A}_{t-1}$ represents the history of exposure to wealth shock at wave *t*
- L_0 represents baseline covariates
- β_{0t} is a wave-specific intercept

Figure 4.A1 Causal Diagram for Negative Wealth Shock and All-Cause Mortality

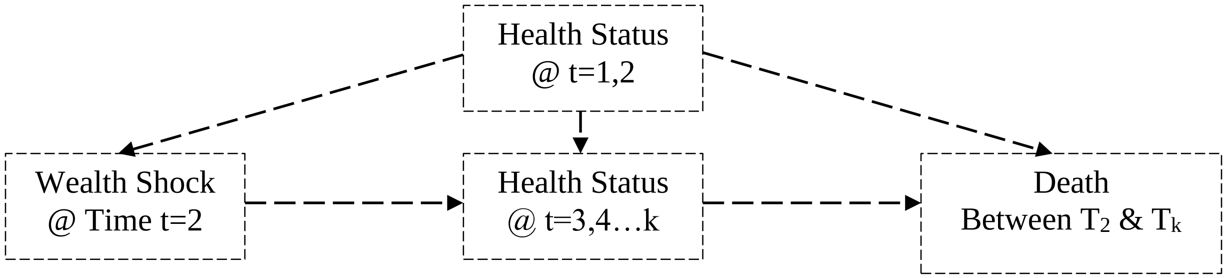


Table 4.A1 Preconditions for the Use of Marginal Structural Models

Precondition	Justification
Does health status predict wealth shock?	A predictor of negative wealth shock is major illness onset and the resultant medical bills.[92]
Does wealth shock predict future health status?	In previous research, negative wealth shocks have been associated with short-term health effects, including increased risk of mental health problems, suicide, and substance abuse.[42-47,49,53,117] Additionally, in Chapter 3 of this dissertation, negative wealth shock was associated with a higher risk of depression.
Does past health predict future health, independent of wealth shock?	Independent of economic status, self-rated health predicts future morbidity and mortality.[134]
Do both wealth shock and health status vary over time?	In this analysis, both negative wealth shock and health covariates are time-varying predictors measured in each wave.

Table 4.A2 Inverse Probability Weight Distribution

	IPW Model	Estimated Weights	
	c-stat	Mean (SD)	Min/Max
Inverse Probability Weights	0.765	1.00 (0.26)	0.07-19.3

Abbreviations: c-stat, Concordance statistic; IPW, inverse probability weight; SD, standard deviation.

Table 4.A3 Inverse Probability Weight Distribution by Year

Year	Mean	Standard Deviation
1994	1.00	0.14
1996	1.00	0.18
1998	1.00	0.20
2000	1.00	0.22
2002	1.01	0.24
2004	1.01	0.32
2006	1.01	0.33
2008	1.01	0.33
2010	1.01	0.34

Chapter 5

Negative Wealth Shock in Late Middle Age and Longitudinal Trajectories of Cognitive and Physical Function

5.1 Background

In older age, chronic health conditions are common, and epidemiologic studies that focus on a single risk factor at a single time point for a single health outcome may not adequately characterize conditions that result from multimorbidity, long induction and latency periods, or exposure to multiple time-varying risk factors throughout the life course. Focusing instead on global changes in cognitive and physical functioning provides a method for examining functional capacity change that may occur due to multiple risk factors, as indicated by the Disablement Process, a theoretical model of aging positing that the process of transition from disease to disability occurs over a period of time, accelerated or slowed by personal and environmental factors.[137] Some amount of normative decline is expected in older age[138,139] but it is the accelerated declines that result in disability that are of particular burden, through medical costs, caregiving needs, and reduced quality of life. Therefore, much interest is given to risk factors for accelerated cognitive and physical decline.

Previous research has indicated a number of modifiable health behaviors and antecedent health conditions that are associated with accelerated aging and late-life declines. Smoking, non-moderate alcohol consumption, physical inactivity, high dietary intake of sodium and saturated fats, and low dietary intake of fruits and vegetables are high-risk health behaviors associated with both cognitive and physical decline.[140,141] Individual cardiometabolic risk factors, including hypertension, elevated serum cholesterol, diabetes, and obesity, as well as cerebrovascular and cardiovascular disease, are also associated with increased risk of cognitive and physical declines in later life.[142,143] Depression has been linked to cognitive and physical declines, while osteoarthritis, cancer, and lung dysfunction are associated with later-life physical declines only.[143] Furthermore, research on the combined effects of the risk factors has shown an additive effect, whereby the reported number of risk behaviors and chronic conditions is linearly associated with risk of cognitive and physical decline.[144,145]

In addition, a range of social determinants are thought to play a role in accelerated aging and decline. Social factors have the ability to predispose or buffer the experience of health risk factors, but additionally, social factors can influence health through direct embodiment of stress and disadvantage.[146] Lower socioeconomic status, including levels of income, wealth, and social position, are associated with accelerated aging.[147-149] These associations persist for SES across the life course, illustrating the long-term impact of sustained economic disadvantage.[3,150] In conjunction with SES, other psychosocial factors are associated with cognitive and physical declines. Exposure to acute stressful life events and chronic perceived stress are associated with accelerated declines[151,152] while more robust social networks and higher levels of social engagement are associated with slower declines.[153,154]

In the wake of the Great Recession, there has been increased interest in the health consequences of economic downturn and wealth shock. Much of the research has focused on short-term changes in health and well-being, and has found increased risk of mental health problems,[42-44,49] suicide,[46,47] substance use,[53,117] and loss in sense of control after wealth loss.[57] Several studies have focused on more long-term health consequences of economic and labor market conditions. Macroeconomic downturn in childhood or early adulthood is associated with late-life cognitive and physical decline, perhaps through reduced occupational mobility or fewer years of work-related cognitive engagement.[155-157] Unemployment during midlife is associated with lower levels of cognitive and physical functioning in older age, through a hypothesized pathway of stress and loss of assets.[80,158] However, no study has yet directly examined how a sudden loss of wealth in midlife – a negative wealth shock – shapes long-term trajectories of cognitive and physical function.

Economic security has particular saliency for persons in the late middle age, pre-retirement period. In accordance with the economic theory of the life-cycle hypothesis, there are periods of savings across the life course, when consumption is lower than current income, and periods of dissaving, when consumption exceeds current income.[62] Retirement is considered a dissaving period, as persons often rely upon assets to maintain their standard of living as their income diminishes. Late middle age is typically seen as a time when wealth is maximized in anticipation of retirement. After a negative wealth shock occurs during late middle age, there are fewer years to remain in the workforce replenishing lost assets, and thus expected standard of living after retirement may fall.[71]

The stress of losing substantial wealth during the savings period of the life cycle and the resulting expectation that standard of living will be lower in retirement may lead to stress-related health consequences, including accelerated cognitive and physical declines in later-life. Indeed, expectation of a reduced standard of living in older age is associated with worse physical and cognitive functioning in later life.[159] Furthermore, persons who anticipate fewer resources in retirement may reduce consumption in the present, irrespective of current income, which may include forgoing health-enhancing goods and services.[64] This, in turn, may lead to poor management of existing chronic conditions, hastening further health declines. For example, individuals who report financial barriers to health care services or medication after acute myocardial infarction have higher rates of rehospitalization.[74]

There is debate on whether wealth loss is causally related to poor health, or if it is merely a result of poor health. Medical debts are the leading reason for bankruptcy filings, and a major contributor to home foreclosures in the United States.[60] We hypothesize a bidirectional association, in which health conditions can result in wealth shock and experiencing a negative wealth shock is causally associated with further health declines. Much of the previous literature on wealth shock has utilized exogenously-driven shocks, like stock market volatility[49] or job loss due to plant closings or layoffs,[80] to ensure health problems are not the cause of the wealth loss.

In this paper, we estimate the association between negative wealth shock during late middle age and cognitive and physical trajectories into older age, using a nationally representative sample of US adults age 50 and older. We hypothesize that experiencing negative wealth shock will accelerate both cognitive decline and physical limitation accumulation. We address the challenge of the potentially bidirectional relationship between negative wealth shock and poor health by using a marginal structural modeling approach,[82] which allows for adjustment of health conditions prior to the wealth shock without muting the health changes that may occur on the pathway from negative wealth shock to cognitive and physical decline.

5.2 Methods

Study design and data source

The Health and Retirement Study (HRS) is a longitudinal study of US adults, enrolled at age 50 and older. For this analysis we use data from the original HRS cohort, born in the years 1931-1941. These individuals have been surveyed biennially since 1992 with detailed modules on financial status and health.[122] The most recent wave of available data is 2012, as obtained from the RAND HRS file, version N.[85] HRS was approved by the Institutional Review Board at the University of Michigan and all participants signed informed consent.

The sample for this paper includes only those with longitudinal measurement and some amount of net worth at baseline; 619 participants were excluded because they did not have longitudinal measurement and thus we were unable to distinguish whether they experienced a negative wealth shock and another 858 participants were excluded because they had zero or negative net worth at baseline. It is unknown whether these individuals had lifelong asset poverty or experienced a negative wealth shock prior to study entry; in both cases, they would not be at risk for a negative wealth shock during the follow-up period. There were 9,750 participants in the original HRS cohort, and of those, 8,273 participants (84.9%) were eligible for this analysis. As compared to the total sample, persons who were excluded due to asset poverty were more likely to be female and non-White, with lower socioeconomic status and poorer health. Persons who were excluded due to lack of longitudinal measurement were more likely to be male and non-White, with similar socioeconomic status but poorer health.

Negative Wealth Shock Measurement

A module assessing net worth was administered at every wave of HRS. Measured assets include housing value, net value of businesses, individual retirement accounts, checking/savings accounts, certificates of deposits and savings bonds, investment holdings, net value of vehicles, and the value of any other substantial assets. From this asset total, debts were subtracted, including home mortgages, other home equity loans, and unsecured debt values, like credit card balances, student loans, and medical debts. Missing values for wealth were imputed at the level of each asset or debt, using an unfolding bracket imputation method.[86] Wealth data were not imputed for those who do not participate in a given wave.

Negative wealth shock was measured and then dichotomized (yes or no) for each time point in late middle age (50-64). Loss of 75% or more of total wealth between two consecutive waves was used as the cut-point for negative wealth shock. Persons were considered at risk for negative wealth shock until they experienced wealth shock or reached age 65.

Cognitive functioning

Cognitive functioning is assessed in HRS using the Telephone Interview for Cognitive Status (TICS). The full HRS cognitive battery is not available for participants under 65. We use an abbreviated measure that included questions about episodic memory (Immediate Word recall (10 points) and Delayed Word recall (10 points) and mental status (Serial 7's (5 points), backwards counting from 20 (2 points).[160] All responses were combined to create a composite score. The range of the score is 0-27, with a higher score indicating higher cognitive function. Cognitive measures are imputed for each cognitive test, meaning the cognitive summary score may include one or more imputed scores.[161] Persons who participate via proxy interview do not complete the cognitive assessment and these interviews were excluded from the cognitive analyses. Cognitive data from 2012 are not yet available in the RAND HRS file, so follow-up for this outcome occurred only through 2010.

At baseline in 1992, the full TICS battery was not assessed, and instead two episodic memory tests were conducted: Immediate Word recall (20 points) and Delayed Word recall (20 points). We include an baseline episodic memory summary score (range 0-40; mean 13.1±5.2) in the analytical models to adjust for potential confounding due to cognition differences prior to negative wealth shock.

Physical Functioning

Physical function was measured using a series of 17 questions on mobility, strength, motor skills, and performance of activities of daily living.[162] Participants were asked “Please tell me whether you have any difficulty doing …” for the following functions: running or jogging a mile; walking several blocks; walking across a room; walking one block; sitting for about 2 hours; getting up from a chair; climbing several flights of stairs; climbing one flight of stairs; stooping, kneeling, or crouching; extending arms above shoulders; pushing or pulling large objects; lifting or carrying over 10 pounds; picking up a dime from the table; getting in and out of bed; bathing; dressing; and eating. Participants were instructed to exclude any difficulties expected to last less than three months. Responses affirming difficulty with the activity or stating that they “can’t do” the activity at all were coded as 1. The responses were summed to create a composite physical functioning score. The range of the score is from 0-17, with a higher score indicating more limitations.

When participants were asked each question on physical function, they were given the opportunity to say that they “don’t do” the function, instead of responding yes, no, or “can’t do” to having difficulties doing the particular function. A “don’t do” response is coded as missing. A missing variable is, in essence, a zero variable in the physical function summary score. In some cases, a person may not do the function because they cannot do the function without difficulty, and thus their physical function summary score would be underestimated. To address this potential source of bias, we recoded “don’t do” responses, using a strategy, outlined in the Appendix.

The wording of the physical function questions was asked differently at baseline in 1992; the emphasis was on how much difficulty the participant had in doing an activity. We include a baseline physical function summary score in the analytical models (range 0-17) to adjust for potential confounding, but this score is not directly comparable to future year scores.

Demographic Characteristics

Demographic characteristics were measured at baseline were included in the models as time-invariant characteristics, including age at baseline, gender (male or female), self-reported race/ethnicity (Hispanic, non-Hispanic Black, non-Hispanic White, non-Hispanic other race), and educational attainment (in years).

Sociodemographic Status

Sociodemographic status covariates were measured at each wave and were modeled as time-varying variables for each wave that a participant was in late middle age and at risk for negative wealth shock. These characteristics included income (adjusted to 1992 dollars using the Consumer Price Index and then logged), labor force status (working, unemployed and looking for work, retired, work-limiting disability, or homemaker), marital status (married/partnered, divorced, widowed, or never married), and health insurance coverage (yes or no).

Health Status

Health status covariates were also measured at each wave and were modeled as time-varying variables for each wave that a participant was in late middle age and at risk for negative wealth shock. Continuous variables were recoded into categorical variables if random or structural zeros were present in diagnostic assessment. A main assumption of the marginal structural analysis approach is positivity, which requires both exposed and unexposed individuals at each level of the covariates.[82]

Health status covariates include: self-rated health (excellent, very good, good, fair, or poor); history of three physician-diagnosed health conditions - stroke (yes or no), hypertension (yes or no), and diabetes (yes or no); alcohol use (none, 1-2 daily drinks, or 3 or more daily drinks); smoking status (current smoker, former smoker, or never smoked); elevated depressive symptoms based on responding yes to experiencing three or more of eight Center for Epidemiology Studies Depression Scale (CES-D) symptoms; physical activity (vigorous physical activity for 3 or more days per week, yes or no); number of chronic conditions (0, 1, and 2 or more); and body mass index (BMI) (kg/m^2, categorized as <18.5/underweight, 18.5-24.9/normal weight, 25-29.9/overweight, >=30/obese).

Statistical Methods

Descriptive statistics display the distribution of demographic, socioeconomic, and clinical covariates at baseline in 1992. These descriptive statistics are stratified by negative wealth shock in late middle age, though at baseline none of the sample had yet experienced a measured negative wealth shock. We plotted unadjusted year-specific mean cognitive and physical function scores, based on time-varying negative wealth shock exposure.

Because negative wealth shock is a time-varying exposure influenced by time-varying covariates that may act simultaneously as confounders and mediators, a standard regression modeling approach might lead to overadjustment of estimates and bias toward the null.[82] We therefore use a marginal structural modeling (MSM) approach for all multivariable models, in which time-varying confounding is adjusted via inverse probability of exposure weights (IPWe) that balance the exposure group at each follow-up period in late middle age.

IPWe weights are estimated from pooled logistic models predicting the probability of not being exposed to negative wealth shock for each participant i at each time point t in late middle age.[135] We use a two model approach for the calculation of stabilized weights.[123] The numerator model includes as independent predictors only baseline covariates, while the denominator model includes baseline and time-varying covariates. Odds ratios from the IPWe denominator model, estimating the association between the covariates of interest and negative wealth shock, are listed in Table 5.1. Predicted probabilities from the numerator model are divided by the predicted probabilities from the denominator model. This provides a stabilized weight (SW^E) for each person *i*.

IPWe Calculation Formula:

$$SW_i^E(t, S_t) = \prod_{k=1}^{S_t} \frac{pr(A_k | \overline{A}_{k-1}, \overline{G}_k = 0, L_0)}{pr(A_k | \overline{A}_{k-1}, \overline{G}_k = 0, \overline{L}_k)}$$

where

- A_k represents the exposure to wealth shock at time *k*
- $\overline{A}_{k-1}$ represents the history of exposure to wealth shock
- $\overline{G}_k$ equals 0 if the participant is alive and age is <65 years at time *k*, and equals 1 if the participant has been censored due to age, death, or other
- L_0 represents baseline covariates
- $\overline{L}_k$ represents baseline and time-varying covariates up to time *k*
- S_t represents the number of time intervals that participant *i* is in late middle age

When the resulting weights are applied in the final model, the analytical sample is up-weighted for covariate vectors that have a low probability of negative wealth shock and down-weighted for covariate vectors that have a high probability of negative wealth shock. This weighting creates a pseudopopulation free from confounding.[82] Stabilized weights that deviate substantially from 1.0 indicate misspecification of the models. To improve model precision, we truncated the IPWe weights at the first and 99th percentiles.[136] The mean, standard deviation, and range of the truncated IPWe are listed in Table 5.2 for the cognitive and physical decline covariate IPWe models.

Because negative wealth shock is associated with a higher mortality rate (Chapter 4), mortality attrition is differentially distributed between the exposed and unexposed in this analysis. To account for mortality-related attrition that may be potentially informative, we estimated inverse probability weights of mortality attrition (IPWm).[163] Calculation of the IPWm is similar to the IPWe; the probability of not dying at a given year is predicted using the same vector of covariates included in the exposure weight. Odds ratios from the IPWm denominator model, estimating the association between the covariates of interest and mortality during follow-up, are listed in Table 5.1. Including the IPWm weights in the final model up-weights individuals with similar characteristics as those who have died, to represent the contribution those individuals would have had on the model estimates. We truncated the IPWm at the first and 99th percentiles to improve precision. Mean, standard deviation, and range of the IPWm weights are listed in Table 5.2.

Using these inverse probability weights, we created two analytical weights for the final model, one incorporating the IPWm weights and another that omits the IPWm weights. The final models are run twice, with each of the two analytical weights. For the first set of analytical weights, we multiplied the HRS survey weights by the IPWe weight.[123] The HRS time-varying complex survey sampling weights corresponding to the year of the outcome measurement, which accounts for loss-to-follow-up attrition and allows these estimates to be population-representative parameters for noninstitutionalized US adults in the cohort and years examined. For the second set of analytical weights, we multiplied the HRS survey weights by the IPWe weight by the IPWm weight.

Using the analytical weights, we estimated the association between negative wealth shock and both cognitive and physical decline using generalized estimating equation (GEE) regression models.[100] Negative wealth shock is a time-varying exposure that is assumed to be an absorbing state, meaning that participants may have earlier observations in which they are considered as not having a wealth shock, but once they have had a wealth shock they are consistently coded as wealth shocked in all subsequent years. The model allows for the rate of change in cognitive or physical function to shift after the negative wealth shock occurred to assess differential decline over time. In both the cognitive and physical function models, we regressed the summary score against a main effect of time in years and a time spline for those who have experienced negative wealth shock by time *t*.

After preliminary analyses examining potential confounders, the cognitive and physical decline models were adjusted for baseline age, gender, race/ethnicity, educational attainment, baseline net worth tertile, income, labor force status, marital status, health insurance coverage, baseline cognitive function, self-rated health, stroke, hypertension, diabetes, alcohol use, smoking status, elevated depressive symptoms, and an interaction between baseline age and time. The physical function limitation accumulation models were additionally adjusted for baseline physical function, physical activity, number of chronic conditions, and BMI. All analyses were run using SAS 9.3 (SAS Institute, Cary, NC).

5.3 Results

Of the 8,273 participants with positive net worth at baseline, 1,456 had a negative wealth shock during late middle age, which is equivalent to 16.0% of the US late middle aged asset-holding population, when complex survey sampling weights are applied. Those who had a negative wealth shock were more likely to die during follow-up (32% versus 24%), but were less likely to drop out of the study (6% versus 10%). As a result, mean follow-up time was nearly equivalent for those who did or did not experience wealth shock (17.6 and 17.7 years, respectively).

At baseline, as compared to those who never had a negative wealth shock, those who would go on to have a wealth shock were more likely to be female, non-white race/ethnicity, and have lower levels of socioeconomic indicators, including educational attainment, household income, household net worth, working for pay, and marriage/partnership (Table 5.3). Those who later experienced negative wealth shock also had higher levels of health risk factors, including smoking, drinking, uninsurance, and number of chronic conditions. Those who had a negative wealth shock had lower levels of cognitive function and more physical function limitations at baseline.

Mean baseline cognitive and physical function limitation scores by selected covariates are listed in Table 5.4. Those with lower socioeconomic status and poorer health status had lower levels of cognitive function and higher levels of physical function limitations at baseline. Figure 5.1 shows the mean cognitive function (A) and physical function (B) scores by negative wealth shock status in each year of follow-up. In these unadjusted graphs, those who experience negative wealth shock have consistently lower levels of cognitive function and higher levels of physical function limitations.

Results from the marginal structural models for cognitive decline are listed in Table 5.5. Average cognitive function score declines by 0.131 annually (P<0.001). Negative wealth shock during late middle age is associated with an additional annual decline in cognitive function of 0.026 (P=0.02). When adjusting for mortality attrition, additional annual decline in cognitive function attributable to negative wealth shock increases to 0.033 (P=0.01), which is equivalent to 25% additional annual decline in cognitive function.

The marginal structural model results for physical function limitation accumulation are listed in Table 5.6. Average physical function limitations increased by 0.08 annually (P<0.001).

The annual increase in physical function limitations is 0.005 higher for those who experience negative wealth shock, but does not reach the level of conventional statistical significance (P=0.61). This pattern remains with adjustment for mortality attrition.

Graphical interpretations of the MSM model results with mortality attrition weights applied are shown in Figure 5.2. A participant who has a negative wealth shock in the 6th year of follow-up will have a cognitive score that is 0.48 points lower and a physical function limitation score that is 0.13 points higher at year 20 of follow-up as compared to those who never had a negative wealth shock.

5.4 Discussion

This paper examines whether negative wealth shock in late middle age is associated with cognitive and physical functioning trajectories into older age. In this analysis, we found a small, but statistically significant association between negative wealth shock in late middle age and accelerated cognitive decline. We did not find a significant difference in physical function limitation accumulation between those who did and did not have a negative wealth shock. For both of these outcome measures, cognitive function and physical function, those who experienced negative wealth shock had worse functioning at baseline and each wave of follow-up. Concurrent with this poor functioning were higher levels of deleterious health behaviors and health conditions. Given the differences in health at baseline, it is possible that poor health may have contributed to the incidence of negative wealth shock in this population. We attempted to adjust for health status and other sociodemographic characteristics that may precede the negative wealth shock without muting the health changes that may be on the pathway from wealth shock to functional status, such as increased risk of depression, by using a marginal structural modeling approach.

Our research contributes to the growing literature on the health risks of wealth loss and economic crisis, and provides evidence that negative wealth shock may have long-term associations with cognitive decline. Previous research has demonstrated consistently strong associations between wealth shock and health conditions that suggest a pathway of increased stress, such as depression,[42-44,49] substance use,[53,117] and suicide.[46,47] Further evidence of negative wealth shock as a stressful life event has been shown via associations between wealth shock and psychosocial changes concurrent with stress, including loss of sense of control[57] and increased social stigma.[58] Accelerated late-life cognitive decline has been associated with stress and adversity, conceivably mediated by mental health conditions.[152,164] Stressful life events are an established risk factor for depression,[103] and depression in both midlife and late-life is associated with a higher risk of cognitive decline and dementia.[112,165] Sustained activation of the hypothalamic–pituitary–adrenal (HPA) axis is indicated both in onset of depression and hippocampal degeneration.[104]

While both depression and stressful life events in midlife have been associated with physical functioning,[113,151] we did not see a significant association between negative wealth shock and accumulation of physical limitations in our sample. Levels of limitations were elevated prior to baseline, and thus, there may have already been accelerated decline that contributed to the occurrence of negative wealth shock but prevented us from observing larger effects thereafter. It is also possible that our scale of physical function may not have been sufficiently sensitive to increases in limitation accumulation after negative wealth shock. We use a scale that assumes linear accumulation over time, when in reality, recovery from physical function limitations is common. Furthermore, social factors, including socioeconomic status, are associated with recovery from these limitations.[166,167] While previous research has also modeled physical function as a linear outcome,[80,150,151,159] the scale used in this analysis was somewhat nonnormally distributed. We explored other functional forms, results were approximately equal to the linear model. Future research should continue to examine negative wealth shock and late-life physical function.

This paper is subject to other limitations. First, though the mean duration of follow-up was over 17 years, we may have observed smaller changes in cognitive and physical decline – including small differences between those who did and did not experience wealth shock – because of limited follow-up into older age. In the final wave of available data, the mean age was 75 years, with a range 70-82 years. Given that there are steeper declines in functioning with increasing age,[168] we might have observed larger differences with additional follow-up time. Second, we constructed a measure of negative wealth shock using extensive testing of common predictors of wealth shock to determine an appropriate cut-point in wealth loss (Chapter 2). It is possible that there is non-differential misclassification of participants as wealth shocked or not wealth shocked. This would bias our findings toward the null. Third, though the use of the marginal structural model was appropriate in this analysis, there is a reduced statistical efficiency in adjusting for confounders through inverse probability weighting, resulting in larger standard errors than in model-based confounding adjustment.[136] Additionally, in the MSM, interactions with time-varying covariates cannot be modelled.[82] Changes in cognitive or physical functioning that are brought about by changes in time-varying factors were not considered in this analysis.

The strengths of the study outweigh the limitations. HRS is a nationally representative sample of persons enrolled in late middle age in 1992 and followed continuously through 2012.

The long duration of follow-up in both late middle age and older age allows for measurement of a time-varying negative wealth shock exposure, as well as longitudinal trajectories of cognitive and physical function. Wealth can be difficult to ascertain, is often subject to recall bias, and is not frequently assessed longitudinally in epidemiologic cohorts.[17] Because the economics of retirement is a main focus on HRS, there is biennial measurement of detailed wealth questions that are harmonized across survey time points, with an unfolding bracket imputation approach to provide additional stability across estimates.[86] This high-quality measurement of wealth provides validity to our measure of negative wealth shock. We use an MSM approach to adjust through the inverse probability weighting for factors that may simultaneously act as mediators and confounders. Because there may be a bidirectional association between negative wealth shock and health, use of this rigorous causal model is a key strength.

While we recognize that there are multiple methods to account for mortality attrition, this paper uses inverse probability weighting. The rationale for using this approach is that there may be uncontrolled factors that influence both selection as well as cognitive and physical declines.[163] We adjust for a variety of health conditions and other factors associated with mortality, but there may be other genetic and personal factors that influence both survival after negative wealth shock and accelerated cognitive and physical declines. A downside to the use of mortality attrition IPW is that up-weighting people who survive in poor health (i.e., those who are most comparable to the deceased) changes the relative importance of sociodemographic and health substrata, because weighting is not accounting for missing data but rather data that is undefined.[169] An alternative method to compensate for mortality attrition is principal stratification.[170] This method examines associations within counterfactual strata: those who would survive regardless of wealth shock, those who would die regardless of wealth shock, and those who would survive based on wealth shock status. While the stratum to which each participant belongs cannot be known, methodologic tools exist to estimate likely strata. Further research should apply and compare principal stratification methodology.

In this nationally representative analysis of US adults, 16% of those who held assets had a negative wealth shock during late middle age. Those who experienced negative wealth shock had faster cognitive decline over the duration of follow-up, with an additional annual decline of over 25%. However, we did not find a significant difference in physical function limitation accumulation among those who did or did not have a negative wealth shock. These findings contribute to the growing body of evidence on the health risks associated with economic downturn and wealth loss, and adds the first examination of differential cognitive and physical decline after negative wealth shock. Given the high population prevalence of negative wealth shock, this may be an important risk factor for accelerated cognitive aging.

Table 5.1 Odds of *Not* Experiencing Negative Wealth Shock and Odds of *Not* Experiencing Mortality During Late Middle Age, by Selected Baseline and Time-Varying Sociodemographic and Health Covariates

	Negative Wealth Shock Model		**Mortality Attrition Model**	
Covariate	OR	95% CI	OR	95% CI
Baseline Age (in years)	1.04	(1.01, 1.06)	0.95	(0.92, 0.97)
Female (vs. male)	0.99	(0.85, 1.14)	1.64	(1.44, 1.87)
Race/ethnicity (vs. White)				
Black	0.61	(0.52, 0.72)	1.07	(0.87, 1.31)
Hispanic	0.65	(0.50, 0.85)	1.28	(1.00, 1.64)
Other Race	0.52	(0.35, 0.77)	1.34	(0.81, 2.22)
Educational Attainment (in years)	0.99	(0.96, 1.01)	0.97	(0.95, 1.00)
Baseline Net Worth (vs. $1-$59,500)				
$59,501 – $176,000	2.47	(2.08, 2.93)	1.05	(0.89, 1.25)
>$176,000	2.66	(2.14, 3.31)	1.01	(0.87, 1.18)
Baseline Cognitive Function Score	1.01	(1.00, 1.03)	1.00	(0.99, 1.01)
Baseline Physical Function Score	1.00	(0.98, 1.02)	1.01	(0.99, 1.03)
Household Income, logged	1.13	(1.08, 1.18)	1.01	(0.95, 1.08)
Marital Status (vs. married/partnered)				
Divorced/Separated	0.58	(0.47, 0.70)	0.82	(0.66, 1.02)
Widowed	0.62	(0.50, 0.77)	0.76	(0.65, 0.88)
Never Married	0.77	(0.53, 1.10)	0.83	(0.57, 1.20)
Labor Force Status (vs. working)				
Unemployed	0.73	(0.51, 1.04)	0.80	(0.47, 1.37)
Retired	1.19	(0.98, 1.44)	0.71	(0.60, 0.84)
Disabled	0.70	(0.53, 0.92)	0.78	(0.61, 1.00)
Homemaker	1.03	(0.80, 1.33)	0.83	(0.65, 1.07)
Health Insured (vs. uninsured)	1.49	(1.23, 1.81)	0.91	(0.64, 1.28)
Self-Rated Health (vs. Excellent)				
Very Good	1.26	(1.05, 1.51)	0.91	(0.66, 1.25)
Good	1.15	(0.91, 1.44)	0.56	(0.42, 0.76)
Fair	0.91	(0.71, 1.16)	0.27	(0.20, 0.37)
Poor	0.67	(0.49, 0.91)	0.10	(0.07, 0.14)

Table 5.1 Odds of *Not* Experiencing Negative Wealth Shock and Odds of *Not* Experiencing Mortality During Late Middle Age, by Selected Baseline and Time-Varying Sociodemographic and Health Covariates

	Negative Wealth Shock Model		**Mortality Attrition Model**	
Covariate	OR	95% CI	OR	95% CI
Alcohol Use (vs. 1-2 daily drinks)				
None	0.84	(0.70, 1.01)	0.78	(0.66, 0.92)
3 or more daily drinks	0.82	(0.62, 1.10)	0.92	(0.66, 1.30)
Smoking Status (vs. Never)				
Former	0.92	(0.78, 1.09)	0.69	(0.60, 0.79)
Current	0.76	(0.62, 0.93)	0.40	(0.34, 0.46)
Hypertension (yes vs. no)	0.89	(0.78, 1.01)	0.83	(0.74, 0.94)
Diabetes (yes vs. no)	0.93	(0.79, 1.10)	0.59	(0.53, 0.67)
Stroke (yes vs. no)	0.60	(0.47, 0.78)	0.68	(0.55, 0.84)
Elev. Depressive Symptoms (yes vs. no)	0.78	(0.66, 0.92)	0.86	(0.74, 0.99)

Abbreviations: CI, confidence interval; OR, odds ratio.

Table 5.2 Inverse Probability Weights of Negative Wealth Shock and Mortality Attrition in a Sample of Late Middle Aged US Adults, Truncated at 1st and 99th Percentiles

	Inverse Probability Weight of Negative Wealth Shock Exposure (IPWe)		Inverse Probability Weight of Mortality Attrition (IPWm)	
	Mean (SD)	Range	Mean (SD)	Range
Cognitive Function Model	1.00 (0.17)	0.41-1.81	1.00 (0.21)	0.44-2.02
Physical Function Model	1.00 (0.17)	0.40-1.85	1.01 (0.23)	0.43-2.13

Abbreviation: SD, standard deviation.

Table 5.3 Baseline Characteristics by Negative Wealth Shock During Late Middle Age, Weighted by Respondent-level Sample Weights, Health and Retirement Study (N=8,273)

	Participants without Wealth Shock (n=6,817)	Participants with Wealth Shock (n=1,456)
Age in years, mean (SE)	55.8 (0.04)	54.3 (0.10)
Sex, %		
Female	51.9%	55.5%
Male	48.1%	44.5%
Race/Ethnicity, %		
Hispanic	4.5%	10.7%
Non-Hispanic Black	6.6%	16.4%
Non-Hispanic White	86.9%	69.7%
Non-Hispanic Other Race	1.9%	3.2%
Education, mean (SE)	12.7 (0.08)	11.7 (0.14)
Household Income, Median	$43,800	$26,479
Household Net Worth, Median	$134,979	$36,182
Net Worth Tertile, %		
$1-$59,500	23.6%	60.3%
$59,501 – $176,000	35.4%	21.6%
>$176,000	41.0%	18.1%
Marital Status		
Married/Partnered	82.0%	68.0%
Divorced/Separated	10.4%	19.4%
Widowed	4.8%	7.7%
Never Married	2.9%	4.9%
Employment Status, %		
Working	69.1%	63.5%
Unemployed	2.2%	4.5%
Retired	16.5%	13.1%
Disabled	1.8%	6.5%
Homemaker	10.3%	12.3%
Health Insurance, %	89.2%	73.9%

Table 5.3 Baseline Characteristics by Negative Wealth Shock During Late Middle Age, Weighted by Respondent-level Sample Weights, Health and Retirement Study (N=8,273)

	Participants without Wealth Shock (n=6,817)	Participants with Wealth Shock (n=1,456)
Self-Rated Health Status, %		
Excellent	26.0%	20.6%
Very Good	32.9%	23.7%
Good	26.1%	27.1%
Fair	10.4%	18.5%
Poor	4.6%	10.1%
Regular Physical Activity, %	19.9%	20.3%
Body Mass Index, mean (SE)	26.8 (0.07)	27.5 (0.17)
Alcohol Use, %		
None	33.5%	44.0%
Moderate (1-2 daily drinks)	61.6%	50.2%
Heavy (3 or more daily drinks)	4.9%	5.8%
Smoking Status, %		
Never	37.9%	33.1%
Former	38.6%	31.2%
Current	23.5%	35.7%
# Chronic conditions, mean (SE)	0.9 (0.02)	1.1 (0.04)
Hypertension, %	30.1%	34.3%
Diabetes, %	6.9%	11.0%
Stroke, %	1.5%	2.8%
Word Recall Score, mean (SE)	13.6 (0.132)	12.5 (0.210)
Physical Function Score, mean (SE)	3.2 (0.07)	4.1 (0.12)
Follow-up time, mean (SE)	17.7 (0.06)	17.6 (0.12)
Mortality During Follow-up, %	24.2%	32.4%
Drop Out of Study During Follow-up, %	10.0%	5.7%

Abbreviation: SE, standard error.

Table 5.4 Mean Baseline Cognitive and Physical Function Scores, by Selected Sociodemographic and Health Covariates, Health and Retirement Study, 1992

	Cognitive Function Score Mean (SE)[a]	Physical Function Score Mean (SE)[b]
Sex		
Female	14.2 (0.16)	3.8 (0.08)
Male	12.5 (0.13)	2.77 (0.06)
Race/Ethnicity		
Hispanic	11.5 (0.32)	3.60 (0.10)
Non-Hispanic Black	10.7 (0.14)	3.67 (0.17)
Non-Hispanic White	13.8 (0.14)	3.26 (0.07)
Non-Hispanic Other Race	12.8 (0.50)	2.90 (0.39)
Education		
Less than High School	11.1 (0.19)	4.21 (0.12)
High School	13.3 (0.15)	3.46 (0.08)
Some College	14.4 (0.19)	2.94 (0.08)
College Degree or Higher	15.1 (0.18)	2.38 (0.06)
Net Worth Tertile		
$1-$59,500	12.2 (0.17)	4.27 (0.11)
$59,501 – $176,000	13.5 (0.17)	3.18 (0.07)
>$176,000	14.3 (0.13)	2.67 (0.06)
Marital Status		
Married/Partnered	13.5 (0.13)	3.22 (0.07)
Divorced/Separated	13.0 (0.25)	3.64 (0.13)
Widowed	12.5 (0.29)	3.81 (0.21)
Never Married	12.6 (0.42)	3.41 (0.22)
Employment Status		
Working	13.6 (0.14)	2.66 (0.05)
Unemployed	12.9 (0.40)	2.99 (0.20)
Retired	12.9 (0.17)	4.81 (0.17)
Disabled	10.8 (0.25)	8.83 (0.27)
Homemaker	13.8 (0.25)	3.96 (0.14)
Health Insurance		
Yes	12.6 (0.21)	3.73 (0.11)
No	13.5 (0.13)	3.24 (0.07)

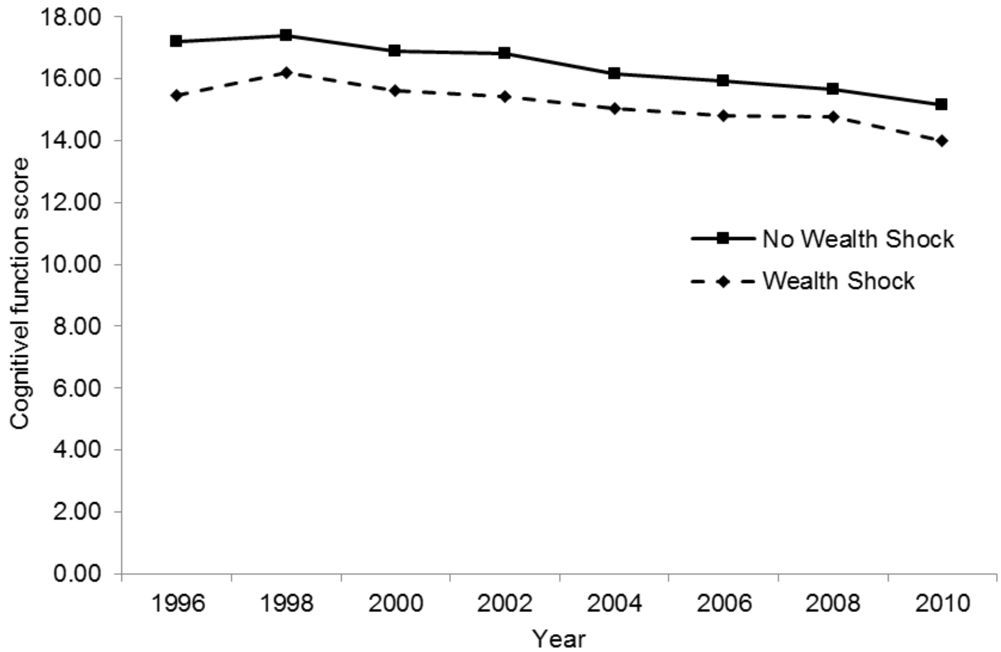
Table 5.4 Mean Baseline Cognitive and Physical Function Scores, by Selected Sociodemographic and Health Covariates, Health and Retirement Study, 1992

	Cognitive Function Score Mean (SE)[a]	Physical Function Score Mean (SE)[b]
Alcohol Use		
None	12.8 (0.19)	3.91 (0.09)
Moderate (1-2 daily drinks)	13.8 (0.13)	2.97 (0.07)
Heavy (3 or more daily drinks)	12.6 (0.31)	3.16 (0.17)
Smoking Status		
Never	13.8 (0.18)	3.16 (0.09)
Former	13.2 (0.15)	3.19 (0.08)
Current	13.1 (0.16)	3.70 (0.09)
Self-Rated Health Status, %		
Excellent	14.3 (0.18)	1.75 (0.04)
Very Good	14.0 (0.17)	2.61 (0.04)
Good	12.7 (0.16)	3.41 (0.10)
Fair	12.3 (0.21)	5.59 (0.12)
Poor	11.2 (0.23)	9.12 (0.20)
Ever Had Hypertension		
Yes	13.0 (0.19)	4.07 (0.10)
No	13.6 (0.12)	2.97 (0.06)
Ever Had Diabetes		
Yes	12.2 (0.22)	5.00 (0.18)
No	13.5 (0.13)	3.17 (0.07)
Ever Had Stroke		
Yes	12.4 (0.49)	6.29 (0.36)
No	13.4 (0.13)	3.25 (0.07)

Abbreviation: SE, standard error.
[a] Higher cognitive function score corresponds to higher cognitive function (higher is better).
[b] Higher physical function score corresponds to higher number of physical functioning limitations (higher is worse).

Figure 5.1 Mean Cognitive and Physical Function Scores by Negative Wealth Shock Status, Health and Retirement Study

A Cognitive Function



B. Physical Function

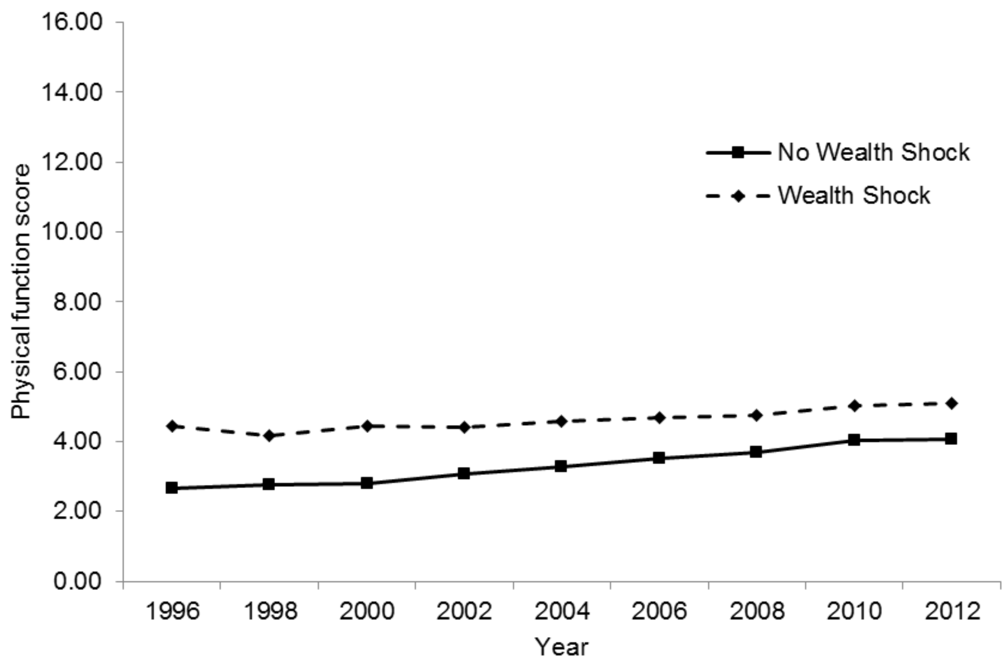


Table 5.5 Rate of Change in Cognitive Function by Time-Varying Negative Wealth Shock Status as Predicted by Marginal Structural Models[a] and Attrition Weights, Health and Retirement Study

	Cognitive Function Decline	Cognitive Function Decline with Mortality Attrition Weight
	Estimate (95% CI)	Estimate (95% CI)
Annual decline for those who have not had a negative wealth shock	-0.131 (-0.143, -0.119)	-0.133 (-0.145, -0.120)
Increase in annual decline for those who have a negative wealth shock	-0.026 (-0.050, -0.003)	-0.033 (-0.058, -0.009)

Abbreviation: CI, confidence interval.
[a] Models are adjusted for the following covariates: baseline age, gender, race/ethnicity, educational attainment, baseline net worth tertile, baseline cognitive function, income, labor force status, marital status, health insurance coverage, self-rated health, stroke, hypertension, diabetes, alcohol use, smoking status, elevated depressive symptoms, and an interaction between baseline age and time.

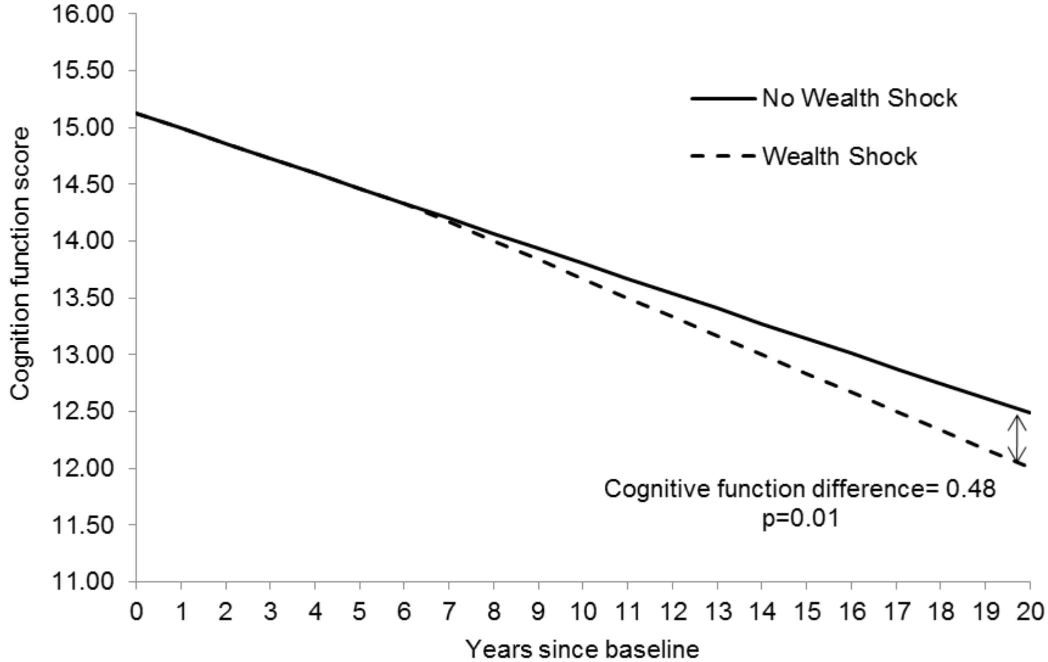
Table 5.6 Rate of Change in Physical Function by Time-Varying Negative Wealth Shock Status as Predicted by Marginal Structural Models[a] and Attrition Weights, Health and Retirement Study

	Physical Function Limitations Increase	Physical Function Limitations Increase with Mortality Attrition Weight
	Estimate (95% CI)	Estimate (95% CI)
Annual increase for those who have not had a negative wealth shock	0.080 (0.069, 0.092)	0.084 (0.072, 0.097)
Increase in annual increase for those who have a negative wealth shock	0.005 (-0.015, 0.025)	0.009 (-0.012, 0.030)

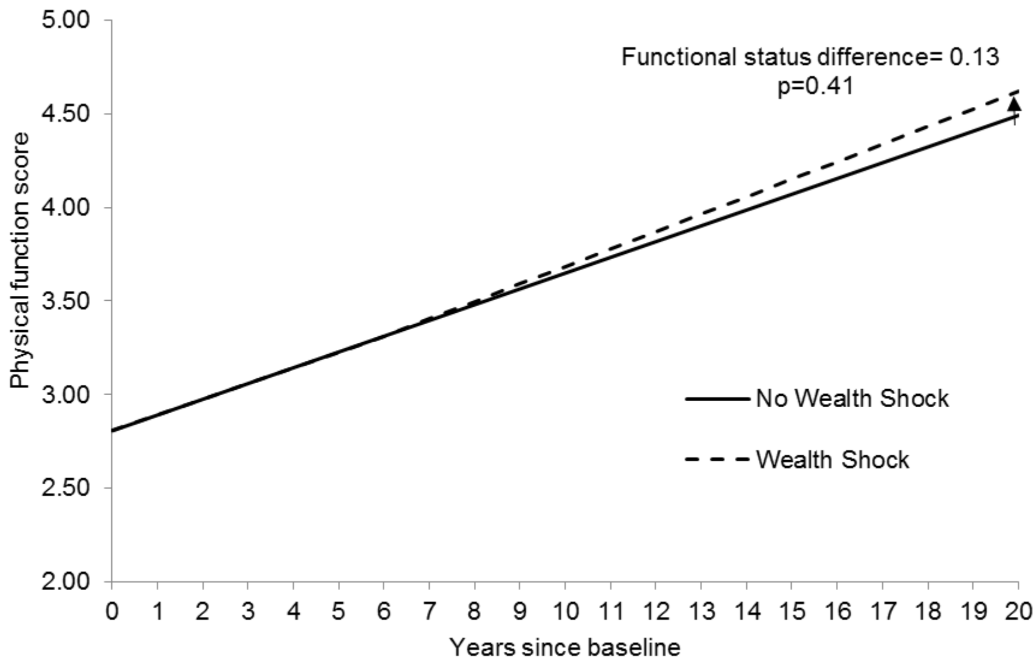
Abbreviation: CI, confidence interval.
[a] Models are adjusted for the following covariates: baseline age, gender, race/ethnicity, educational attainment, baseline net worth tertile, baseline cognitive function, baseline physical function, income, labor force status, marital status, health insurance coverage, self-rated health, stroke, hypertension, diabetes, alcohol use, smoking status, elevated depressive symptoms, physical activity, number of chronic conditions, body mass index, and an interaction between baseline age and time.

Figure 5.2 Cognitive and Physical Function Over Time[a] by Negative Wealth Shock Status, Health and Retirement Study, 1992-2012

A Cognitive Function



B. Physical Function



[a] The predicted values are derived from multivariable-adjusted generalized estimating equation models.

5.5 Appendix: Recoding “Don’t Do” Responses to Physical Function Limitation Questions

When participants were asked each question physical function, they were given the opportunity to say that they “don’t do” the function, instead of responding yes, no, or “can’t do” to having difficulties doing the particular function. A “don’t do” response is coded as missing. Because a missing response would function as a zero in the physical function summary score, we recoded “don’t do” responses to create a physical function summary score would not be underestimated. We used concurrent health conditions and prior wave reporting of physical functioning limitations to guide the decision making. Table 5.A1 lists the decisions rules that were applied in the recoding process, and Table 5.A2 shows the frequencies of the each of the responses to the physical function limitation questions prior to and after recoding was applied.

Table 5.A1 Decision Rules Used in the Recoding of Physical Function Limitation Variables

Participant Characteristics	Recoding Decision
Reports having an ADL limitation at time *t*	All "don't do" responses are recoded as 1: Some difficulty
Reports having "fair" or "poor" self-rated health at time *t*	All "don't do" responses are recoded as 1: Some difficulty
Reports having "good" self-rated health with 2 or more chronic conditions at time *t*	All "don't do" responses are recoded as 1: Some difficulty
Reports having "good" self-rated health with 0-1 chronic conditions at time *t* and reported difficulty with a specific function at time *t-1*	The "don't do" response for the function that was previously reported as having some difficulty is recoded as 1: Some difficulty
Reports having some difficulty climbing one flight of stairs	The "don't do" response for climbing several flights of stairs is recoded as 1: Some difficulty
Reports having some difficulty walking across room	The "don't do" response for walking several blocks and walking one block are recoded as 1: Some difficulty
Reports having some difficulty walking one block	The "don't do" response for walking several blocks is recoded as 1: Some difficulty
Reports having any walking mobility difficulties	The "don't do" response and the other missing responses for jogging 1 mile are recoded as 1: Some difficulty
All other combinations of participant characteristics	"don't do" responses are recoded as 0: No difficulty

Table 5.A2 Frequencies of Responses to Physical Function Limitation Variables Before and After Recoding Decision Rules Applied

	Original Data (N=55,736)				After Recoding (N=55,736)		
	1:Some Diff n (%)	0: No Diff n (%)	.X: Don't Do n (%)	Other Missing n (%)	1:Some Diff n (%)	0: No Diff n (%)	Other Missing n (%)
Walking Across Room	2,689 (4.82)	52,998 (95.09)	14 (0.03)	35 (0.06)	2,703 (4.85)	52,998 (95.09)	35 (0.06)
Dressing	4,354 (7.81)	51,342 (92.12)	6 (0.01)	34 (0.06)	4,360 (7.82)	51,342 (92.12)	34 (0.06)
Bathing	2,638 (4.73)	53,057 (95.19)	6 (0.01)	35 (0.06)	2,644 (4.74)	53,057 (95.19)	35 (0.06)
Eating	1,257 (2.26)	54,434 (97.66)	13 (0.02)	32 (0.06)	1,270 (2.28)	54,434 (97.66)	32 (0.06)
Getting Out of Bed	2,753 (4.94)	52,924 (94.95)	24 (0.04)	35 (0.06)	2,774 (4.98)	52,927 (94.96)	35 (0.06)
Walking Several Blocks	14,142 (25.37)	40,798 (73.2)	737 (1.32)	59 (0.11)	14,687 (26.35)	40,990 (73.54)	59 (0.11)
Walking 1 Block	6,435 (11.55)	48,982 (87.88)	267 (0.48)	52 (0.09)	6,663 (11.95)	49,021 (87.95)	52 (0.09)
Sitting for About 2 Hours	10,453 (18.75)	44,789 (80.36)	439 (0.79)	55 (0.1)	10,683 (19.17)	44,998 (80.73)	55 (0.1)
Getting Up From A Chair	20,512 (36.80)	35,091 (62.96)	72 (0.13)	61 (0.11)	20,560 (36.89)	35,115 (63.00)	61 (0.11)
Climbing Several Flights of Stairs	22,418 (40.22)	29,257 (52.49)	3,942 (7.07)	119 (0.21)	24,890 (44.66)	30,727 (55.13)	119 (0.21)
Climbing One Flight of Stairs	8,201 (14.71)	46,429 (83.3)	1,024 (1.84)	82 (0.15)	9,027 (16.20)	46,627 (83.66)	82 (0.15)
Lifting or Carrying Over 10 lbs.	10,900 (19.56)	43,604 (78.23)	1,174 (2.11)	58 (0.1)	11,794 (21.16)	43,884 (78.74)	58 (0.1)
Stooping, Crouching or Kneeling	23,846 (42.78)	31,273 (56.11)	555 (1)	62 (0.11)	24,255 (43.52)	31,419 (56.37)	62 (0.11)
Picking a Dime Up	3,539 (6.35)	52,075 (93.43)	122 (0.22)	61 (0.11)	3,591 (6.44)	52,084 (93.45)	61 (0.11)
Reaching or Extending Arms	8,090 (14.51)	47,447 (85.13)	149 (0.27)	50 (0.09)	8,214 (14.74)	47,472 (85.17)	50 (0.09)
Pulling or Pushing Large Objects	12,172 (21.84)	41,104 (73.75)	2396 (4.3)	64 (0.11)	13,795 (24.75)	41,877 (75.13)	64 (0.11)
Jog 1 Mile	16,019 (28.74)	7,887 (14.15)	16,869 (30.27)	14,961 (26.84)	36,820 (66.06)	18,893 (33.90)	23 (0.04)

Chapter 6

Conclusion

6.1 Summary

This dissertation investigated both short-term and long-term health consequences of negative wealth shock during late middle age using data from US-based Health and Retirement Study (HRS), while applying rigorous design and statistical models to address bidirectional causation and time-dependent confounding that may influence the associations between negative wealth shock and health outcomes. In Chapter 2, we provided detail on how the negative wealth shock exposure was conceptualized and measured; we use a cut-point of loss of 75% or more of total net worth between two consecutive biennial waves. In Chapter 3, we nested a crossover study design within the longitudinal HRS, which allows for the estimation of odds of elevated depressive symptoms and cost-related medication non-adherence after negative wealth shock using within-person conditional models. When compared to more conventional between-person pooled logistic models in which both of the associations were highly significant, results from the crossover were similar for depressive symptoms, but were attenuated and non-significant for medication non-adherence. In Chapter 4, we used a marginal structural modelling (MSM) approach to estimate the association between negative wealth shock during late middle age and all-cause mortality measured over a 17-year follow-up period. Negative wealth shock was associated with a 37% higher hazard of mortality over the follow-up period. Furthermore, this association persisted across levels of baseline net worth, indicating a loss of 75% or more of net worth may lead to premature mortality, regardless of dollar amount of loss. Finally, in Chapter 5, we again used the MSM approach to estimate the influence of negative wealth shock in late middle age on 17-year trajectories of cognitive and physical declines. Negative wealth shock in late middle age was associated with faster cognitive decline during follow-up, but was not associated with accelerated accumulation of physical function limitations.

6.2 Emerging Themes

Building on the findings of the dissertation chapters, several cross-chapter themes emerge, including the influence and endurance of specific hypothesized pathways from negative wealth shock to health, the sociodemographic influences on the incidence of negative wealth shocks and the resulting health outcomes, and the implications of the application of causal methods.

Pathways of Influence from Negative Wealth Shock to Health Outcomes

Recalling Figure 1.1 from the dissertation introduction, we hypothesized two pathways from negative wealth shock to health outcomes: (1) psychosocial changes related to perceived stress, and (2) reduced consumption of health-related goods and services due to perceived financial strain. In Chapter 3, we tested these pathways via short-term health changes that are strong indicators of perceived stress and financial strain. There was strong evidence of an association between negative wealth shock and elevated depressive symptoms in a within-person model that was adjusted by design for all time-invariant confounding. This indicated that negative wealth shock may indeed lead to significantly elevated stress levels, as shown by higher levels of elevated depressive symptoms after wealth shock. In contrast, cost-related medication non-adherence was not significantly higher after negative wealth shock in a within-person model, indicating that residual confounding may account for a strong between-person association and offering little support for the hypothesized consumption change pathway.

We further hypothesized that these pathways may lead to sustained health changes that could be seen through associations between negative wealth shock and long-term trajectories of health in older age. In Chapter 4, negative wealth shock in late middle age was associated with a higher risk of mortality. Negative wealth shock has been associated with higher suicide risk in previous studies,[46-48,51] and stress is hypothesized to mediate that association. However, as seen in our analyses through a test of proportional hazards assumption, the rate of all-cause mortality for those who experienced negative wealth shock was elevated throughout the follow-up period. Studies that examine elevated stress levels and delaying or foregoing needed medical care have shown associations with increased mortality,[119,171] and thus both of our hypothesized pathways could have contributed to the findings in Chapter 4.

In Chapter 5, we found a significant association between accelerated cognitive decline among those who experienced negative wealth shock during late middle age, but did not find an association with accelerated physical function limitation accumulation. Previous evidence has suggested chronic stress levels may lead to increases in cognitive decline.[152] It may be that the activation of the stress pathway after negative wealth shock was the primary contributor to the cognitive decline finding. Physical function decline has also been linked to increased stress,[151] but if the stress pathway is activated after negative wealth shock, it was not contributing to faster physical decline in our sample.

This research contributes to the growing literature on stress-related consequences of negative wealth shock.[42-53] We did not find specific evidence of an activation of the consumption pathway, but given the strong theoretical basis in the economics literature to support this pathway,[64] more research on consumption after wealth shock is needed.

Sociodemographic Influences on Negative Wealth Shock and Subsequent Health Outcomes

We observed many sociodemographic differences in the incidence of negative wealth shock during late middle age. Those who had a negative wealth shock were more female, non-White, and had lower levels of educational attainment, income, and net worth prior to the shock. Undoubtedly, some of these sociodemographic differences were attributable to the design of the negative wealth shock exposure variable. By using a cut-point of 75% or more of loss in net worth, we prioritized relative loss of net worth above absolute loss of net worth. For example, a person who has a lower net worth at baseline can lose a much smaller absolute amount and still reach the 75% cut-point as compared to a person who has a high amount of net worth at baseline. Persons who had lower amounts of net worth are then disproportionately likely to enter the negative wealth shocked sample. Given the strong associations between net worth and income, race, and gender,[18] some of the sociodemographic patterning is likely attributable to using a percentage amount of loss.

Sociodemographic differences may persist for other reasons. First, numerical ability and financial literacy can impact wealth-related decisions including choice of asset types, risky investments, and retirement planning.[172,173] Both numerical ability and financial ability are highly correlated with educational attainment,[174] which in turn is correlated with other sociodemographic characteristics. Second, the differences in negative wealth shock due to sociodemographics may be attributable to health status. Non-White race, having lower educational attainment, and having lower economic status are associated with higher levels of chronic conditions,[18] which may result in high medical care costs, a leading predictor of negative wealth shock.[60] Lastly, there is a long and complex history of racism in the ability to accumulate and maintain wealth.[175,176] Previous research has found that persons of color are steered into riskier assets and given less favorable terms when accessing credit, which may increase vulnerability to negative wealth shock.[177] This was apparent in the aftermath of the Great Recession when it was revealed that racial and ethnic minorities had been disproportionately offered subprime mortgage loans while white borrowers with similar credit profiles received prime mortgage loans.[178]

In Chapter 4, we examined interactions between negative wealth shock and three sociodemographic factors – race/ethnicity, gender, and baseline net worth – for potential differences in the associations negative wealth shock with all-cause mortality. We hypothesized that the perceived stress and strain of experiencing negative wealth shock might be different for racial and ethnic minorities and women, as these subgroups tend to report differing levels of perceived stress and exposure to stressful life events.[179] We also hypothesized differences in the pathways from negative wealth shock to health may be different depending on absolute net worth loss. For each of these sociodemographic factors, we found no evidence of differences in the rates of mortality after negative wealth shock. We conclude that although women and people of color are more likely to have a negative wealth shock, they do not have differential health-related outcomes due to the wealth shock. We also conclude that a high relative loss of wealth is deleterious for health, across all dollar amounts of loss.

There were also sociodemographic differences among persons who were excluded from the dissertation analyses due to having zero or negative net worth at baseline. We excluded these individuals because it unknown whether these individuals had lifelong asset poverty or experienced a negative wealth shock prior to study entry. Those excluded were also more female, non-White, and had lower levels of educational attainment (Table 2.5). Some of the reasons for sociodemographic differences between those who did and did not experience negative wealth shock, such as poorer health status and discrimination influencing the ability to generate wealth extend to the excluded individuals. It is important to acknowledge and emphasize that the generalizability of our findings extends only to those who have asset holdings, and that there are sociodemographic differences in those who have asset holdings as compared to those who do not.

Application of Analytical Methods

This dissertation uses alternative analytic methods to address the complex and likely bidirectional relationship between negative wealth shock and health outcomes. Comparing results from these methods with estimates from conventional regression models can highlight the utility and the challenges inherent in these methods.

In Chapter 3, we used a crossover study design to have control over both the patterning and timing of the negative wealth shock exposures, examining elevated depressive symptoms and cost-related medication non-adherence before and after negative wealth shock using within-person conditional logistic regression. We compared these results to between-person estimates from a pooled logistic model. Estimates for elevated depressive symptoms were similar from the within-person and between-person models, which provides some reassurance that the between-person model estimates are not driven by unmeasured confounding. However, the estimates for CRN were quite different in the between-person and within-person models. The within-person estimates were attenuated and non-significant, indicating that the between-person association may be have been influenced by residual confounding that we hypothesize may be due to gradations in insurance coverage. This is an important finding that can guide future research, but the trade-off is that the crossover study has a limited sample size because only exposed persons could be included in the model. Decreased precision limited our ability to do subanalyses or test for potential effect modification.

In Chapters 4 and 5, we used a marginal structural modelling (MSM) approach. The added value of the MSM approach is adjusting for time-varying confounding through inverse probability weights (IPW), which adjusts for covariables that potentially confound the association between negative wealth shock and long-term health outcomes, without overadjusting for the potentially mediating health-related changes that may be on the pathway from wealth shock to long-term health. In Chapter 4, we compared the MSM regression model with a non-MSM conventional model adjusted for baseline and time-varying covariables. In the MSM approach, negative wealth shock during late middle age was associated with a 37% higher mortality rate, while in the non-MSM model, negative wealth shock in late middle age was associated with only a 22% higher mortality rate. The attenuated estimate from the non-MSM model indicates that there may be substantial mediation by worsening health status that also confounds the association between negative wealth shock and mortality.

There are several drawbacks to using the MSM approach. MSM estimates tend to have larger standard errors, which affect precision of the estimates. This was particularly of issue in Chapter 5, when we were examining relatively small changes in cognitive and physical function over time. Additionally, because of the covariable adjustment approach in the MSM, it is not possible to model interactions between negative wealth shock and time-varying covariables.[82] We were unable to consider potential modification of the associations between negative wealth shock and cognitive and physical decline by the time-varying covariables.

Conditional models and MSM models are considered to be approaches that can approximate causal effects.[82,97] These methods are especially informative for exposures that individuals cannot be randomized into treatment and control groups. Because negative wealth shock is an economic exposure that cannot be analyzed in a randomized control trial, these models may provide the closest approximation to a causal effect. Nevertheless, the causal nature of the associations in our analyses should not be overstated. This dissertation remains an observational study, and part of the body of existing research on negative wealth shock.

6.3 Strengths and Limitations

A major strength of this study is the use of the Health and Retirement Study. HRS is a nationally representative sample of late middle aged adults that have been followed biennially through 2012. The large sample size, frequent surveys, and harmonization of both health and economic measures across waves was instrumental for conducting the analyses in this dissertation. Wealth can be difficult to ascertain, is often subject to recall bias, and is not frequently assessed longitudinally in epidemiologic cohorts.[128] The biennial measurement of detailed wealth questions, with an unfolding bracket imputation approach provided stability in wealth across years,[86] providing a higher likelihood that large variations capture through the 75% cut-point were due to "true" wealth shocks.

Furthermore, the causal methods used in these analyses are a major strength of the dissertation, due to the bidirectional association between wealth and health. By using these methods, we were able to minimize the potential for reverse causality and can add evidence to the hypothesis that wealth loss is associated with deleterious health outcomes.

Despite the rigorous and routine measurement of the HRS, there were some variables that may be subject to misclassification. In line with other studies that have used discrete indicators of economic loss like foreclosure or bankruptcy,[43-54] we wanted to use a discrete measure of negative wealth shock that would allow for modeling as a time-varying exposure. We used extensive diagnostic testing to determine an appropriate cut-point, but this still may include some misclassified persons. Other measurement issues arose in Chapter 5. Because HRS conducts a full cognitive battery only for participants age 65 and older,[161] we had to use a reduced measure in the analysis to model cognitive change starting at wealth shock in late middle age. While previous studies have used this measure,[160] usage of the reduced battery may impact the breadth of cognitive measurement. For physical function limitations accumulation, we recoded persons who reported that they "don't do" a specific function to either having or not having difficulty with the function to minimize bias in our physical function summary score. There may be some level of misclassification in this recoding.

There were sample restrictions applied in our analyses which limits the inference to a similar population. Due to support from theories of life course differences in wealth accumulation and health,[62] as well as some previous evidence of differences by age group in the association between negative wealth shock and health,[26-28] only negative wealth shocks that occurred during late middle age were considered in this dissertation. It is likely that some health consequences of negative wealth shock persist outside of this age period, but our results do not reflect heterogeneity in age. Additionally, persons who report no wealth at baseline were excluded from these analyses. It is unknown whether these individuals had lifelong asset poverty or experienced a negative wealth shock prior to study entry; in both cases, they would not be at risk for a negative wealth shock during the follow-up period.

Period differences may also affect inference of this work to a contemporary sample. Chapters 4 and 5 use a sample of persons that were in late middle age primarily during the 1990's, in order to measure long-term term changes in health status. Therefore, negative wealth shock exposure ascertainment occurred primarily in the 1990s, which was the longest period of economic growth in US history.[129] There is some research that suggests that overall population health declines during periods of economic growth,[130] and improves during periods of economic downturn.[23] Our non-wealth shocked comparison population may therefore be slightly less healthy than a comparison population from the Great Recession years, and thus our effect estimates may be smaller in magnitude than they would be if measured during economic downturn.

6.4 Public Health Significance

In this study, we found that a high proportion of late middle-age US adults, 16%, experienced a negative wealth shock during late middle age. Furthermore, we found significantly elevated risks for short-term and long-term health outcomes. This dissertation provides the first evidence that negative wealth shocks in late middle age may have sustained associations with health over time, including all-cause mortality and cognitive decline. The Baby Boomer generation, born between 1946-1964 and representing over 25% of the US population, was in late middle age during the Great Recession, and many experienced negative shocks to their net worth.[180] The additional risk of depression, premature mortality, and cognitive decline that may be expected due to wealth shock in this population has important implications for public health intervention and policy. The following policy and practice recommendations are organized by level of intervention and use a broad "health in all policies" approach.[181]

Policy and Practice Recommendations: Primary Prevention

Primary prevention for this research is the prevention of the causes of negative wealth shock. The single biggest contributor to negative wealth shock in the US is high medical bills. The timeframe for follow-up in these studies was prior to the implementation of the Affordable Care Act (ACA). One of the intentions of the ACA is to limit catastrophic medical expenses through increased insurance coverage and annual out-of-pocket cost maximums.[108] Estimates of the percentage of US adults who are uninsured has fallen since 2010, when the first provisions of the ACA were implemented.[131] Additional efforts should be made to expand health insurance access and affordability, especially in the late middle-aged population.

Another large contributor to negative wealth shock is the additional unemployment, investment loss, and other ramifications that are concurrent with an economic downturn. For this reason, US policies that encourage macroeconomic stability may have downstream effects on health outcomes. Likewise, US policies that offer oversight and regulation of the financial and banking industry might discourage wanton and predatory practices, such as the subprime mortgage loans targeted at communities of color.[178]

Policy and Practice Recommendations: Secondary Prevention

Secondary prevention for this research is the prevention of the negative wealth shock itself. If triggers of wealth shock, such as high medical bills, unemployment, or economic downturn occur, policies that stave off wealth shock may in turn reduce risks of the deleterious health consequences associated with wealth shock. There is evidence that more generous unemployment benefits and active labor market programs that assist in returning people to work may offset the adverse health effects of unemployment by reducing the mediating stress and financial strain.[110-111,182] In the clinical setting, there may be opportunities to identify financial barriers and connect patients with lower-cost treatment regimens, charity care options, and other financial assistance programs.

Policy and Practice Recommendations: Tertiary Prevention

Tertiary prevention for this research is the prevention of the onset and worsening of the health consequences of the negative wealth shock. Once wealth shock has occurred, a strong social safety net could potentially buffer some of the stress and related outcomes. For example, recent research showed that use of food banks rose during the Great Recession.[183] However, providing a strong safety net maybe be challenging during periods budget cuts concurrent with economic downturn; public health activities and expenditures fell during the Great Recession.[184] Prioritizing public health program stability during economic downturn may save lives; persons who report financial strains are less like to seek medical care[74,118] and alternative contact points may be necessary. Building social capital and encouraging social engagement, such as volunteering, may also help buffer some of the health consequences of negative wealth shock.[182] Previous research has shown that giving help to others can buffer the loss of sense of control after wealth shock.[57]

6.5 Future Research Directions

This dissertation represents the first model-based construction of a measure of negative shock to total net worth. This work also includes the first estimation of long-term changes in health that may arise after negative wealth shock in late middle age. Future research could use the exposure measurement outlined in Chapter 2 to examine other potential health consequences of negative wealth shock. In particular, the long-term analyses in this paper could be redone as more data become available from future waves of the HRS, as well as other data sources that measure both wealth and health outcomes. Our sample had a mean age of 75 in the last wave of available data, and steeper declines in cognitive and physical function might be observed as the sample continues to age. Future research might also examine potentially mediating and/or modifying effects in the association between negative wealth shock and health outcomes. The social context of individuals experiencing negative wealth shock may play a role in whether a wealth shocked individual has elevated levels of stress and financial strain, including social support and ability to access the social safety net.

There are strong age group influences in negative wealth shock research. We limited our exposure to persons in late middle age because of the potential for a life course sensitive period; future research should empirically test whether late middle age is indeed a sensitive period to experience negative wealth shock. Furthermore, there are likely to be period and cohort influences, from differing macroeconomic conditions at the time of negative wealth shock as well as earlier in the life course that may influence how are cohort responds to a shock. An age-period-cohort analysis would allow for simultaneous examination of these hypotheses.

Lastly, research on negative wealth shocks should continue to consider and, when possible, test the influence of social policy. As medical debts are a leading cause of wealth shocks and the ACA is intended to decrease catastrophic medical debt, pre-post analysis of the ACA measuring the proportion of late middle-aged adults who have a negative wealth shock could help evaluate whether the ACA has met that objective. Additionally, cross-national comparisons of negative wealth shock prevalence and the resulting health outcomes, between the US and countries with more comprehensive social protection programs, could provide evidence on whether those programs impact population health.

6.6 Conclusion

This dissertation addresses the health consequences of negative wealth shock during late middle age. Results indicate that experiencing a negative wealth shock during late middle age is associated with a higher risk of elevated depressive symptoms after experiencing negative wealth shock, as well as long-term risk of mortality and cognitive decline. Furthermore, negative wealth shocks appear to be deleterious for health across subgroup populations. With over 15% of asset-holding late middle-aged US adults experiencing negative wealth shock, the associated health risks may have a large impact on population health. There are policy and practice intervention points in the prevention of the occurrence of negative wealth shocks and the health consequences thereafter, and implications for additional research.

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